ROCHE

Journal of the Forest Products Research Society

Vol. III, No. 1 February, 1953

See you at 7th National Meeting, June 15, 16, 17, Memphis, Tennessee—Page 3

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JOURNAL OF THE FOREST PRODUCTS RESEARCH SOCIETY

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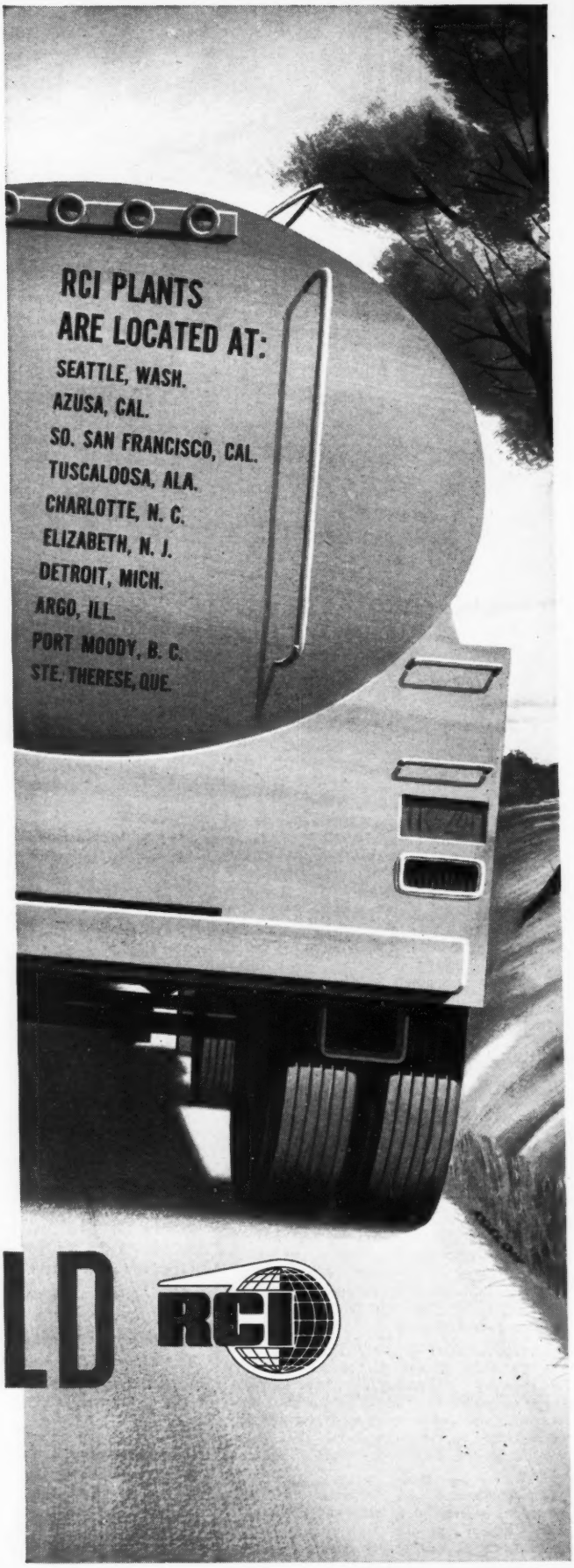

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Journal of the Forest Products Research Society

RESEARCH ★ DEVELOPMENT ★ PRODUCTION ★ UTILIZATION ★ DISTRIBUTION

Vol. III, No. 1 February, 1953

Memphis–Scene of 7th Annual Meeting–June 15-16-17

Memphis, Tenn., site of the June 15–16–17–7th annual meeting of the Forest Products Research Society, has been rapidly forging to the forefront as one of the leading cities of the "new" south. Strategically located at the center of the vast mid-America inland water-ways system, and served by extensive networks of highways railroads and airlines, Memphis is rapidly expanding the vast trade it services and at the same time is becoming and ever increasingly important industrial giant.

As though tailor-made to interest the wood products technologist and the lumber industry executive, Memphis points with pride to the fact it is 1) the world's largest inland hardwood market, 2) the world's largest hardwood charcoal market, and 3) the America's largest producer of hardwood flooring.

Modern Memphis—Capital of a Giant Wood Products Industry

Yet these notable firsts only point the way to the myriad of wood products interests the Memphis visitor will find. Hardwood flooring plants, including some the largest and most modern, hardwood lumber mills, furniture factories, ranging from small specialty shops to nationally known concerns, plywood plants, box and cooperage manufacturers, millwork plants, veneer mills, and a hardwood distillation operation that has run 25 years without a shutdown merely list the highlights of what to see while attending the FPRS meeting at Memphis in June.

A city of 410,712 population (1952 estimate), Memphis manufactures many types of machinery, including woodworking equipment cutterheads and knives, sawmills, machine tools, agricultural equipment, handling equipment and conveyors.

As a distributing center, Memphis ranks 11th in the nation in dollar value of wholesale sales, having increased from $432 million in 1939 to $1,904 million in 1948. The trade area includes counties in seven states and is blanketed by an excellent transportation system radiating out from Memphis.

Phenomenal as Memphis' industrial growth has been in the past decade, the city is now looking forward to greater expansion with the opening of a giant new harbor development (see cover) that will permit new industrial expansion to take full advantage of cheap river transportation. Strange as it seems, for many years Memphis has reaped few benefits from its potentially valuable river location. With the opening of the big President's Island development, the city will have a 960 acre industrial site fronting on a 500-ft.-wide, 12-ft.-deep current free channel. Already 360 acres are available and plants are under construction.

Memphis currently has more than 800 industries manufacturing a diversified line of basic and consumer goods. Included in this list are 19 sawmills and planing mills, 5 veneer mills, 58 millwork plants, many small but others big and nationally known, 5 plywood plants, 10 box factories, 2 cooperage plants, 7 wood preserving plants, including both manufacturers of preservative and actual treating plants, and 17 unclassified wood plants turning out handles, chopping blocks, battery separators and a wide variety of other products.

There are 25 furniture factories making strictly wood furniture, some large and well known. In addition, 17 plants make upholstered wood furniture.

In addition to the above interesting wood products operations, Memphis can boast of paper and paperboard plants, venetian blind manufacturers, and one of the nation's pioneer hardwood distillation plants.

As can be seen, Memphis is a "Wood City' which is well worth a visit. Most plants are conveniently reached and a number of the most interesting ones will be included on the list of plant tours for the June meeting.

Ballroom—Peabody Hotel, Memphis

For the Ladies—A Visit to Memphis Affords Genuine Pleasure

Memphis, home of the Cotton Carnival, which is highlighted by the King and Queen of Cotton, huge parades with gay floats, and street dancing, has many fascinating points of interest to occupy one's time. Being

(Continued on page 68)

THIS MONTH'S COVER

Men and Memphis—Forest Products Industry leaders and one of the nation's largest and most diversified wood products cities—are bidding to make 7th Annual Forest Products Research Society National Meeting the biggest and most informative in the Society's history. In the background is $50 million Memphis industrial development. Meeting officials, left to right, back row, are: R. D. Pauley, National Program Chairman; James Wiseman, E. L. Bruce Co., Member-at-Large of the Steering Committee; Dan Copp, Wilco Machine Works, Co-Chairman, Finance Committee; Henry H. Willins, National Oak Flooring Mfgrs. Assn., Chairman of General Arrangements Committee; Richard Wilson, Wilco Machine Works, Co-Chairman, Finance Committee; and FPRS National President Ken G. Chesley. Front row, left to right, are: James R. Massey, International Harvester Co., Chairman of Public Relations Committee; W. Jeter Easen, Nickey Bros., National Meeting Chairman; and L. J. Heatherly, Southern Hardwood Producers, Inc., who is assisting Massey.

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These Men Arranged Technical Program for June 15–16–17 Meeting

Technical Program Chairman R. D. Pauley, Manager, Special Products Division, Weyerhauser Timber Co., Tacoma, Wash., has been in over-all charge of organizing the technical program, choosing session topic heads, and generally directly his committee's work. Pauley received a B. S. degree in Architectural Engineering from Iowa State College, Ames, Iowa. From the time of his graduation until January, 1952, he was Manager, Development Center, Weyerhaeuser Timber Co., Longview, Wash., and was closely associated with the many new wood and bark by-products which were developed there. In his present capacity, Pauley coordinates sales and production of all Weyerhaeuser bark and whole wood fiber products and the fiberboard now being produced at the company's Klamath Falls, Ore., plant.

Pauley, an FPRS charter member, is a former Northwest Regional Board Member and a former National Vice-President. He is currently the Society's President-Elect as well as Program Chairman of the 1953 National Meeting. He was General Chairman of the 1950 National Meeting and Industry Show at Portland, Ore., and has been variously FPRS National Membership Chairman and National Budget and Finance Chairman.

Pauley reports he is especially indebted to members of his committee, who have worked long and hard in obtaining a well balanced group of papers that will contribute much valuable information to the field of wood technology.

George Marra

L. A. Patronsky

Charles Latimer, Quality Control Engineer, Nickey Bros., Inc., Memphis, Tenn., has arranged the program for Session I on Quality Control, and has chosen a list of speakers who will cover a wide of problems. Latimer took his A. B. degree mathematics at Columbia College, New York City, and his B. S. in mechanical engineering at Oregon State College. His experience includes engineering work at the Brooklyn Navy Yard and Oak

Preliminary Program

Forest Products Research Society Seventh Annual Meeting June 15 to 17, 1953—Memphis, Tennessee

SESSION I—Monday, June 15, 2:00 P. M. Theme: QUALITY CONTROL. Program Arranged by: Charles Latimer, Nickey Bros. Inc., Memphis, Tenn.

"Statistical Quality Control of Thickness of Lumber Core Panels" by Jack Lawlor, National Store Fixtures Company, Inc., Baltimore, Maryland.

"Quality Control in Furniture Manufacture" by Richard C. Calahan, Ass't. Supt. Inspection Dept., Singer Manufacturing Company, South Bend, Indiana.

"Quality Control of Plywood Manufacture" by Robert M. Ripley, Douglas Fir Plywood Association, Tacoma, Washington.

"Some Applications of Statistical Quality Control to the Drying of Lumber" by Willard E. Pratt, California Redwood Association, San Francisco, California.

SESSION II—Monday, June 15, 2:00 P. M. Theme: GLUES AND GLUING. Program Arranged by: Alan A. Marra, School of Natural Resources, University of Michigan, Ann Arbor, Michigan.

"Making the Glue Work" by Ralph Casselman, Pine Lumber Company, Oshkosh, Wisconsin.

"Gluing of Preservative-Treated Oak for Severe Service Conditions" by John Kuenzel, Bureau of Ships, Washington, D. C., N. V. Poletika and H. B. McKean, Timber Engineering Co., Washington, D. C.

"Techniques for Gluing Metal and Plastics to Wood" by Jac Tigelaar, Haskelite Co., Grand Rapids, Mich.

"Properties and Applications of Amino Resin Adhesives and Binders" by E. B. Detwiler, American Cyanamid Company, New York, New York

"Study of the Durability of Woodworking Glues in Different Types of Assembly Joints" by M. L. Selbo, Chemical Engineer, and W. Z. Olson, Technologist, U. S. Forest Products Laboratory, Madison, Wisconsin.

SESSION III—Tuesday, June 16, 9:00 A. M. Theme: CHEMICAL UTILIZATION: Program Arranged by: Program Committee

"Hardwood Pulping as a Utilization Tool—Some Recent Investigations" by John N. McGovern, Division of Pulp and Paper, Forest Products Laboratory, Madison, Wisconsin.

"Outlook for the Utilization of Mesquite" by E. D. Marshall, Lufkin, Texas.

"Wood in a Gulf Coast Chemical Plant" by V. B. Volkening, Chemical Engineer, Dow Chemical Co., Freeport, Texas.

"Delignification of Spruce Sawdust with Chlorine Dioxide" by Dr. H. Schwartz, Superintendent, and Dr. N. Levitan, Forest Products Laboratories, Ottawa, Canada.

SESSION IV—Tuesday, June 16, 9:00 A. M. Theme: CONTAINERS AND PROTECTIVE PACKING MATERIALS. Program Arranged by: Program Committee

"Development of Design Data for Solid Fiberboard Shipping Containers" by K. Q. Kellicutt, Engineer, and E. F. Landt, Technologist, Forest Products Laboratory, Madison, Wisconsin.

"Wood Pallets" by Walter E. Morgan, Morgan Lumber Sales Company, Columbus, Ohio.

"Research in the Packaging Field" by John M. Ladd, Manager Designing and Testing Laboratory, General Box Company, Des Plaines, Illinois.

"Wood Fiber Felts for Protective Packing" by E. O. Lieberg, Manager, Sales Engineering Section, Wood Conversion Company, Cloquet, Minnesota.

"Craveneer as Used in the Packaging Field" by A. L. Whiton, Sales Manager, Chicago Mill and Lumber Company, Chicago, Illinois.

"Ply-veneer Shipping Containers" by J. R. Roberts and A. M. Fisken, Development Department, Weyerhaeuser Timber Company, Longview, Washington.

SESSION V—Tuesday, June 16, 2:00 P.M. Theme: WOOD FINISHING. Program Arranged by: B. E Clatworthy, Radio Corporation of America, Indianapolis, Indiana

Ridge, Tenn. His woodworking experience began with his present job in January, 1948.

Alan A. Marra, Instructor in Wood Technology, U. of Michigan, Ann Arbor, has arranged the program for Session II, on Glues and Gluing, and has chosen papers to study various glues as well as some interesting gluing problems such as gluing wood to metal and plastics. Marra received his B. S. degree from New York State College of Forestry, Syracuse University, in 1940, and his M. S. in 1942. His experience includes project manager, Engineering Research Corp., Riverdale, Md.; Technical Director, Pluswood, Inc., Oshkosh, Wis.; Supervisor, Sales Service Laboratory, Monsanto Chemical Corp., Adhesives Division, Lockport, N. Y.; and Research Engineer in Wood Technology, Engineering Research Institute, U. of Michigan.

His affiliations in addition to FPRS include American Society for Testing Materials, Sigma Xi, and Alpha Xi Sigma.

Louis A. "Pat" Patronsky, Associate Professor of Wood Technology, U. of Michigan, Ann Arbor, has arranged the program for Session VII, on Wood Machining and Equipment, stressing types of tools to gain maximum production, as well as other problems. Patronsky received his B. S. and M. A. degrees in wood technology from the U. of Michigan. Besides his present work, his experience includes employment with the Lenert Aircraft Corp. and work done on Michigan Emergency Conservation. He has worked on a number of research programs sponsored by wood products associations and has been active in sponsoring educational programs geared to wood industry needs. Patronsky was appointed the FPRS Education Committee in 1950 and was 1st Vice-President of the Great Lakes Section in 1951.

Alan A. Marra

B. E. Clatworthy

George G. Marra, Head, Wood Technology Section, Division of Industrial Research, Washington State Institute of Technology, Pullman, Wash., has arranged the program for Session VI, on Wood Composition Board. The session will cover such topics as supply of raw materials for such boards and competitive uses for this raw material. Other papers will describe specific examples of raw wood utilization for composition products. Marra received his B. S. A. M. degrees in Wood Technology from New York State College of Forestry, Syracuse, N. Y., between 1936 and 1942. His experience includes employment by the Army Air Forces as a civilian technologist, and became Chief of Wood Unite, Procurement Division, with duties on the wood aircraft program in the eleven Northeastern states. He later became Civilian Chief of Packaging Branch with headquarters at Wright–Patterson Field, Ohio. Following the war, Marra received his

(Continued on page 68)

"Solubility, Water Absorption and Swelling of Free Films of House Paint" by Dr. F. L. Browne, Forest Products Laboratory, Madison, Wisconsin.

"Preparation of Wood for Finishing" by O. B. Gordon, Behr–Manning Corp., Chicago, Illinois.

"Factors Affecting the Integrity of a Furniture Finish" by P. O. Blackmore, Director, Basic Development Laboratories, Interchemical Corporation, New York, New York.

"Filler—The Theory and Technique of Application" by R. I. Quigley, Vice President, The Lilly Company, High Point, North Carolina.

"Comparison of European and American Finishes" by E. Sigurd Johnson, Professor, North Carolina State College, High Point, North Carolina.

SESSION VI—Tuesday, June 16, 2:00 P.M. Theme: WOOD COMPOSITION BOARD. Program Arranged by: George G. Marra, Washington State Institute of Technology, Pullman, Washington

"The Potential Supply of Raw Materials for Wood Composition Boards" by Elmer Matson, U. S. Forest Service, U. S. Department of Agriculture, Portland, Oregon.

"Specific Examples of Raw Wood Utilization for Composition Products"

"Douglas Fir Plywood Mill Leftovers"

"Ponderosa Pine Woodwork Residues" (Dry Process Hard Boards) by Edward A. Patton, Curtis Cos., Inc., Clinton, Iowa.

"Douglas Fir Slabs and Edgings and Bark" (Wet Continuous Process Hardboard)—by W. J. Runckel, Oregon Lumber Company, Dee, Oregon.

"Kiln Dried Leftovers from Furniture Operations" (Dry Process Panel) by H. C. L. Miller, Miller Hofft, Inc., Richmond, Virginia.

"Competitive Uses for Raw Material Suitable for Composition Products"

SESSION VII—Wednesday, June 17, 9:00 A.M. Theme: WOOD MACHINING AND EQUIPMENT. Program Arranged by: L. A. Patronsky, School of Natural Resources, University of Michigan, Ann Arbor, Michigan.

"Designing Cutterheads for Maximum Production" by Carl Chekouras, Manager, Cutter Division, Yates American.

"New Horizons in Production Through the Use of Tungsten Carbide Tools" by C. E. Drake, President, Drake Corporation, St. Louis, Missouri.

"A Case History of Tungsten Carbide Tools" by Singer Manufacturing Company, South Bend, Indiana.

"High Speed Production of Flooring" by Sidney Miller, E. L. Bruce Co., Memphis, Tennessee.

"Some Engineering Aspects of the Planing Mill" by Peter Koch, Stetson-Ross Machinery Company, Seattle, Washington.

SESSION VIII—Wednesday, June 17, 2:00 P.M. Theme: GENERAL. Program Arranged by: Program Committee

"Wood Preservation by Double Diffusion" by Roy H. Baechler, Division of Derived Products; Forest Products Laboratory, Madison, Wisconsin.

"Recovery of Solvent From Impregnated Wood" by M. S. Hudson, Taylor-Colquitt Company, Spartanburg, South Carolina.

"The Air Seasoning of California Redwood" by Victor H. Clausen, California Redwood Association, San Francisco, California.

"Kiln Drying Water and Swamp Tupelo" by John McMillen, Division of Timber Physics, U. S. Forest Products Laboratory, Madison, Wisconsin.

Research—Road to Future Growth[1]

D. C. EVEREST
Chairman of the Board, Marathon Corporation, Rothschild, Wisconsin

Research in wood has reached the point where what is "up-to-the-minute" today is apt to be obsolete tomorrow, so that management which does not keep pace with research may be headed for a difficult situation. It is probable that we will see more advancement in wiser use of wood in the next five years than we have seen during the past fifty.

THE PURPOSE of your Society is one in which I am deeply interested. All of my life I have been interested in the subject of better utilization of wood.

While I never had the advantage of a technical education, nevertheless, through my association with technically trained men, I have, as Winston Churchill once said, "been able to pick up a little information as I went along my way." Whatever I know about the technical side of research and development has been gained by absorption from men like you. My association with technical people has been of great benefit to me and through practical application has been of benefit to the corporations with which I have been identified.

Having been born in a family which carried on in this country some form of "wood using industry" since about 1640, it is only natural that I should have inherited some of their ideas. It may be said to their credit that they were constantly working on schemes for the better utilization of timber and of the product of the forests. They all had the idea of better utilization and the only limitation of their efforts came about through the economic conditions which existed at the time they were operating.

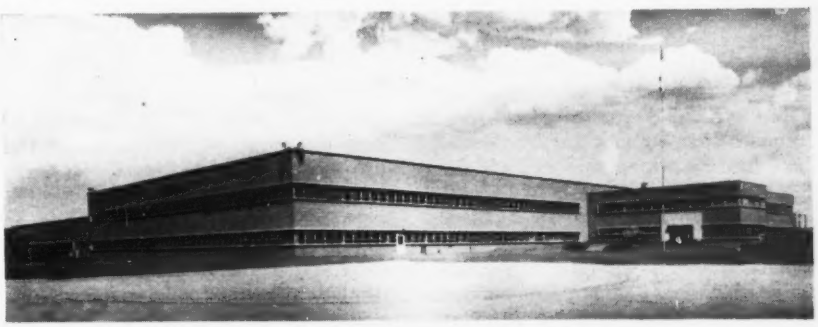
Not long ago I gave a talk at a meeting in Eagle River in which I reviewed the development of the lumber industry as it moved from Maine to the Pacific Northwest. In this talk I took up the cudgel in defense of the so-called "lumber barons." If people would just stop and think about the economic conditions which existed at the time these early lumbermen operated in this and other areas, they would realize that not one of them would ever leave anything in the woods if it were possible to sell it at a profit. This situation we have with us always; it is without question the fundamental reason for the existence of the Forest Products Research Society. Each one of us is working to get more out of a tree and this is activated by the profit motive. We are all endeavoring to not only have better utilization of the primary products in the forest, but also to make better and more lasting things for the public from wood.

Timber is a crop and the sooner people generally realize this the sooner we will replace our wood supply within this area. Many people are aware of this fact and have banded together in organizations which, combined with corporate and individual efforts, will replace our native wood supply.

During the past half century, many organizations and institutions have been built up with the sole purpose of better utilization and the extension of our timber supply. Take, for instance, the Forest Products Laboratory which now does such a magnificent job in Madison and would do more if certain members of Congress would give them more ample appropriations for their use. I do not advocate running to government all the time for money, but, on the other hand, one of the greatest assets the Federal Government has is in timber and if, through the efforts of the Forest Products Laboratory, the value of its timber stands is increased—then the whole country gets the benefit. Unfortunately, I think the member of the Appropriations Committee, or at least a majority of them, have lost their sense of proportion. Too frequently they have been swayed by the political aspect of appropriations, rather than looking after the welfare of the country itself.

It may be interesting to you to know that the Forest Products Laboratory established a branch here in Wausau for the study of all species of wood which might be used in the manufacture of groundwood pulp. It was in 1910 during the time Colonel Henry Graves was Chief of the Forest Service and McGarvey Cline was the Director of the Forest Products Laboratory at Madison. This work was carried on in a building built for the purpose by the local power company, which is today a part of the structure which houses the Vocational School. The work was under the direction of John H. Thickens, ably assisted by George McNaughton and Leslie Sensenbrenner. Practically every specie of wood which had any promise whatever was put through the laboratory on a full scale grinder and the information relative to these tests, which was finally compiled and published by the Forest Service, is still the handbook for those interested in the production of groundwood pulp.

No one can estimate the value of those studies to this country. The same thing is true in the work of the Laboratory in the cooking of sulphite and sulphate pulps by the chemical process and, more recently, by the so-called semi-chemical process. There is no way to evaluate these efforts, but you and I know that these have been of inestimable value, not only to the pulp and paper industry but to the welfare of the country at large. These



Modern plant of Marathon Corporation, Rothschild, Wis.

[1] Presented at meeting of the Forest Products Research Society, Upper Mississippi Valley Section, Dec. 9, 1952, Wausau, Wis.

efforts have extended our wood supply through the utilization of species of wood which fifty years ago were not considered of value at all for the pulp and paper industry. Nor, as a matter of fact, did these species have any place in the lumber or other wood using industries.

In 1913 Marathon Corporation, then known as Marathon Paper Mills Company, established a small laboratory for research work in the manufacture of pulp and also to augment our knowledge of special papers for special purposes. This was in charge of Kenneth King who later became head of the Specialty Division of DuPont Company and retired about two years ago. Shortly after that a small group of men who were interested in the technical side of the business held a meeting in New York and organized the Technical Association of the Pulp and Paper Industry, better known as TAPPI. It was with considerable difficulty that we then found thirty people who were eligible for membership in that association through the fact that they were gainfully employed in technical research in the pulp and paper industry. From that small beginning we have today approximately 5000 members in TAPPI. In a way, your history as a research society parallels that of TAPPI and in your broad field I would predict that your membership will increase at about the same rate as did theirs.

In 1929 the Institute of Paper Chemistry of Appleton was formed and while it is a privately financed institution, nevertheless the contribution it has made in better wood utilization cannot be evaluated and the benefits have been made available to everyone in the country and have not been confined to the people who financed it. In addition to contributing technical knowledge, the important thing is that the Institute has turned out a lot of highly skilled technicians who, in turn, have carried on work in various lines which have also benefitted the country at large.

Individual corporations, notably Nekoosa–Edwards Paper Company, Consolidated Water Power & Paper Company and Rhinelander Paper Company. have done much in the matter of industrial forests and have put much land under good forest management. Trees for Tomorrow, Inc., has done a magnificent job during the eight or nine years of its existence through interesting people in the growing of trees. To round out the whole situation, we cannot overlook the tremendous amount of work which has been done by the State Conservation Commission in all its activities and, above all, the work of the Lake States Forest Experimental Station in St. Paul, which is under the direction of the U. S. Forest Service.

All of these efforts are continuing and in my opinion will eventually renew our forest timber supply in the Lake States. We may not grow the same type of timber which was found here by the original settlers, but we will have a specific use for what we do grow. It is my opinion that within a comparatively short time the annual growth of timber in cubic feet will be in excess of the increment of growth which existed at the time these forests in this area were opened up by the original settlers.

The interest displayed in genetics, entomology, pathology and good forest management is a very hopeful sign and with present-day cost of transportation it is highly important that wood using industries within this area grow their timber within short distances from their plants. The automotive industry has revolutionized the transportation of wood and farsighted men in the railroad industry have been supporting many of these efforts as they realize that in this competitive world, plants located on their lines must be in sound economic position to compete and they are interested in getting the outbound tonnage of these industries.

I well recall when the president of one of the railroad companies, some years ago, said that the "pulp and paper industry within Wisconsin and Northern Michigan was doomed and thought it was hardly worth the effort and expense to republish the freight tariffs." I think if he were alive today and could see what the pulp and paper industry is doing, he would have rather a rude awakening. Present-day railroad officials realize what the wood using industries are up against and I think within the limitations which are imposed on them are trying to do everything they possibly can to assist these industries. Of course, when one is up against a railroad labor law on the one hand and the control of rates on the other, there is not much they can do and still maintain their own existence.

At the Marathon plant in Rothschild, we began in 1927 to make a serious effort toward the utilization of sulphite waste liquor and under the direction of the late Guy C. Howard, from whom we purchased the so-called Howard Process for the isoluation of lignin, we have carried on that work for 25 years. During the past ten years, through pressure for compliance with state laws, many concerns have developed schemes for the utilization of sulphite waste liquor in one way or another. All of these studies and experimental plants, and finally the full stage plants, have cost a tremendous amount of money. However, it is possible through organized work at the Institute of Paper Chemistry and the Forest Products Laboratory, plus the individual and corporate efforts, we may find that the economics of the utilization of this liquor are sound and thus have further assurance of the continuation of operations of the pulp end of the business as a wood using industry.

I have only touched on the pulp and paper business as that is the one with which I am supposed to be familiar, but I think I can see room for improvement in numerous other products now being made by other branches of the wood using industry. That, of course, is the reason for the existence of the Forest Products Research Society. Many other people realize the same thing and with the number of trained technicians who are a mighty smart lot, it behooves one to keep in constant touch with new developments, both in processes and products.

Last Spring I had occasion to talk at a meeting of the Technical Association group in Middletown, Ohio, and I chose for my subject, "Research is Disturbing." I think many of my listeners attended that meeting on account of the subject, as they were not sure whether I would approve or condemn research, particularly if I thought it was disturbing. Of course research is disturbing and particularly to older men in any branch of the wood using industries. They are making a fine product and getting along fairly well and they do not want to be disturbed. Then some smart cookie comes along with a new idea, either as to process or product, and the first thing management knows it has a new problem on its hands and must solve it if it expects to stay in business. That is our competitive system which was designed for just that purpose.

When I was a kid my father manufactured agricultural implements and made a number of products in order to utilize the full cut of a tree, the names of which I presume would not be recognizable to many people today. They made hubs, spokes, felloes, pitman rods, whiffle trees, eveners, tongues, hounds, knees and runners, as well as harrows and cultivators. With the development of the automotive industry, everything which had to do with the manufacture of heavy wagons, buggies, cutters and sleighs gradually went out the window. I suppose my family cussed the Henry

Fords and others who were developing "horseless carriages," but up to the time they discontinued business they were making a transition to supply the new type of spokes and other wood parts used in the automotive industry.

Research today is particularly disturbing as it involves so many new factors more or less connected with the "atomic age," with which few of us are familiar. I thought we had probably exhausted, or at least temporarily stopped, changes in the pulp industry after we got through with the application of varying temperatures and pressures, but now I can see ahead of us a multitude of things we never dreamed of.

With some of the developments going on at the present moment, if I were to consider the building of a new chemical pulp mill, for instance, I would have a rather difficult time deciding on just what type of mill to build. With the way things are progressing, what is "up-to-the-minute" today is apt to be obsolete tomorrow. You fellows and your like are the disturbing elements in this picture and poor old management which does not keep pace with you is headed for a difficult situation. I am all for you and for any other group of technicians, whether they be in the field of power development, nuclear research, or any of the other fields which have been added during the past decade. It is a challenge to management to keep up with these technical developments.

I feel that more has been done in this matter of the growing of wood and its utilization in the past few years than in any previous 25 year period. I well recall the congress on forestry which convened in Milwaukee in 1928 and we had everyone who was interested in the growing and utilization of trees at that conference. They all made wonderful speeches and now, 25 years later, I presume if we had a similar conference they would make the same old speech with but little modification. That was 25 years ago, and inasmuch as I am not aiming to hang around here for another 25 years, I cannot afford to waste much time in getting some of these new ideas into action. Certainly nothing will progress the solution of our problems faster than the work which you technically trained people are doing.

A few years ago, the employees of the Forest Products Laboratory published a booklet, entitled "Toward Wiser Use of Wood." It marked the fortieth anniversary of the establishment of the Laboratory. Incidentally, the last line in that book read as follows: "Not printed at Government expense," which typifies the spirit of the people who have been connected with the Laboratory since its inception. In my opinion, they have been crusaders for a cause and while many of them might have found more lucrative positions in industry, they stuck with the Laboratory. The first two paragraphs of that booklet, under the "foreword," read as follows:

> "At the turn of the century, organized and purposeful research in forest products was practically nonexistent. What little there was consisted of scattered and unrelated experiments in a few university laboratories in the United States and abroad. Its results had little, if any, practical impact upon the wood using industries of the day.
>
> "Fifty years later, research in forest products has become essential to modern industrial progress. In this evolutionary development, the United States has played the leading role. It was in our country that the concept of research, geared to the needs of conservation on the one hand and industrial development on the other was born; and here was launched the first coordinated effort to make that concept a growing reality. Thus was created the United States Forest Products Laboratory."

It is my opinion that the next five years will show more advancement in wiser use of wood than we have seen during the past fifty years. Whenever there is an impending scarcity of anything in this country, there is usually some group of intelligent technically trained people, possessed of good common sense, who come along and devise some way to meet the scarcity. So long as we are dealing with renewable, natural resources, that can be accomplished. While the time element, the cycle of growth, may take longer than any other product of the soil, nevertheless I am confident that this country and Canada can do a job of making the English speaking countries of North America self-sustaining in their raw material supply and economically competitive in world trade through the complete utilization of the forest products and the by-products which may come from new processes.

Not long ago I returned from Washington, D. C., where I attended a two-day meeting of the Secretary of Agriculture's Advisory Committee on Forest Pest Control of which I am a member. This was the second meeting held by that committee. At the first meeting, certain phases of the subject were referred to the Bureau of Entomology and Plant Quarantine and to the Forest Service. They were asked to report at the recent meeting as to the present status of forest pest control work and to give their ideas as to how to combat these pests and the resultant diseases now causing the destruction of our forest resources.

It has always been very evident to me that unless fire, insects and diseases were controlled, there would not be much use in putting much effort on the study of the whole utilization of the products of the future forest. We must continue to protect our present timber supply and grow more trees; otherwise, we will have nothing to utilize.

I doubt if there has ever been as complete a disclosure of the facts relating to forest pest control or as much information given as to why greater progress has not been made in this work than the committee received in this two-day session. Both the Bureaus of Interior and Agriculture cooperated in a way I have not seen before. Men in both bureaus know the answer, but there is another little bureau known as the Bureau of the Budget, which, in my opinion, has lost its ability to evaluate things which give the greatest benefit to the country in the order of their importance. They deal with "horizontal slashes," make no provision for emergencies, and while bugs destroy more timber than fire—Congress follows the lead of the budgeteers and you seldom get much consideration on anything involving a thing as lowly as a bug, except it be a corn borer or a boll wevil. Those bugs seem to influence and control more votes. In the meantime, "Nero fiddles while Rome burns," but is this instance the damage is much worse than fire.

The thing which shocked me in this discussion was the extremely few capable people now working in genetics, biology, entomology, or pathology in the field of our forests and their perpetuation. The Bureau of Entomology and Plant Quarantine have thirty-two entomologists and the Forest Service has thirty-nine who deal with trees. That means only seventy-one full time technical people dealing with the problem of forest pest control in the whole United States and its possessions. Estimates made of the number of entomologists in the United States were between 1000 and 1500 people. No one knew exactly, but say you have 1250 entomologists out of a population of 158 million people—I would say that the entomologists might well have quite a tight little society.

Of course, I think I know why people have not gone into these fields.

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The Human Side of Research Projects[1]

CARL RISHELL

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Like any other human activity, research requires administrative brains and proper personnel. Beyond, management in the lumber industry must think in terms of broad integration toward which research can lead the way.

BACK IN THE THROES of the depression like most of the other 150 million people in the United States, my thoughts were of our economic predicament. In these United States we had and still have every ingredient to provide our people with food, clothing, entertainment, homes, security, old age benefits and all other advantages. We had the raw materials and the technical know-how to convert them into useful products. We also knew that the markets for goods of all kinds were available and that the only thing needed to put this country from depression to prosperity was a perfected organization which would allow our people to go to work in producing the things which they wanted for better living.

The great American people who are noted for their organizing ability and inventive ingenuity failed miserably in finding the answers to our problems. We were saved from the dilemma by an even worse dilemma, that of war. Even after 20 some odd years there has been no adequate answer given to the problems which faced us in the early '30s. The reason for our failure is that we have been unable to evaluate the human side of this research project. The problems involved are more complicated than the development of atomic weapons or the practical utilization of nuclear physics.

Several hundred years ago when this country was first discovered, we had unlimited forests, millions of tons of high grade iron ore, inexhaustible agricultural lands, minerals of every variety, an equitable climate, water power abounded and other natural advantages more bountiful than has ever been given to any other similar land area, but all of these things were as of nothing without the human mind to bring them into use. Practically it is useless to argue whether there is sound if there is no one to hear it. Therefore, about all that these natural resources can mean to any country is the opportunity to use them. There are large areas in South America where resources are abundant, but they are of little value without exploitation by man. They represent unused opportunities.

In the early days beautifully timbered land could be purchased for a few pennies per acre. The timber, some of the finest that has ever been grown, was actually a detriment to the owner. It had to be burned to make profitable use of the soil. Millions of tons of coal were of no value whatever. Hence if one goes back to the beginning, it becomes evident that the things which we possess in life and which we desire to make us comfortable are derived not so much from any particular advantage in natural resources except as one may call the human brain or the ability of a man to work with his hands a natural resource. A dollar bill in your possession has no value except that it will buy the service of some other person's time.

Thus we find that research is no different than any other human activity. With the proper personnel and the necessary administrative brains, it will succeed regardless of the lack of initial physical equipment. A new research building costing millions of dollars creates a great stir within technical organizations and is considered to be evidence that the industry which supports it is up and coming and willing to do battle to preserve its markets. But to get the picture into proper focus we must keep in mind that this building and its wealth of fine equipment represent only two things. First, that these physical assets are but shelter and unused tools incapable in themselves of producing anything. Brains can make tools but tools cannot make brains. Secondly, the buildings represent an opportunity whereby the inhabitants can use the brains of others as well as their own to produce new and greater achievements.

Years ago when I was attending college an old professor told my class as he had many others which preceded it that in the group he was talking to there was probably one embryo scientist and 19 brain plumbers. Of course, he meant that out of that group of 20 people one man because of his ability and the will to use his brains would be a leader, he would be an original thinker and he would be the one person in the group who would use his will power to make use of the brawn and natural intelligence of the other 19 people. His percentages may have been wrong, he was probably too conservative, but the basic reasoning back of his diagnosis cannot be disputed.

Benjamin Franklin, who has sometimes been called the first civilized American and is certainly one of our first and best known scientists, obtained inspiration by reading the lectures of Robert Boyle. Through Boyle he learned that the most exciting discoveries and the workings of nature can be made by keeping one's eyes open and by using apparatus no more elaborate than that which can be found in any well equipped kitchen.

One of Franklin's first useful inventions probably originated on a cold winter night when he was sitting before the fireplace in his father's home. In this state of physical inconvenience he probably wondered why

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it was necessary to put fuel into an opening in the wall and to allow 95% of the heat to escape through the chimney. Actually this was not a very profound observation. It should have been made by others long before his time. He overcame this problem by taking the fireplace out of the wall and putting it in the middle of the room. In this position it could transmit useful heat on all sides instead of one. From this simple act the world possessed the idea for the Franklin stove. (Incidentally, it is in use today.) But that is by no means the end of the story. The use of the Franklin stove would probably have been limited to Franklin's kitchen had he not had an industrial friend who owned a foundry. This friend in casting about for markets hit upon the idea of producing the Franklin stove in iron and selling it to the other inhabitants in Philadelphia. The governor of Pennsylvania was so enthused with the invention that he offered to give Franklin a patent on the contrivance but Franklin refused, saying he was not interested in making money from his invention but desired only to provide comfort for his fellow man. Unfortunately, a London ironmonger not so scrupulous, stole the idea from Franklin, changed it slightly for the worse and had it patented. This thief or "brain plumber" retired comfortably on what he made from another man's invention.

There is also another facet to this story which is very important and often overlooked by research organizations. After Franklin had invented the stove and presented a model to his iron-monger friend, he realized that the invention would not get very far unless he publicized it. Therefore, to promote the product, Ben wrote an advertising booklet entitled "An Account of the New Invented Pennsylvania Fireplaces." From this commonplace story of Franklin's first important invention, we can gain three lessons. First, successful scientific investigations are almost entirely due, initially at least, to the human brain and not to expensive laboratory equipment. Secondly, most inventions are of small use until some person or some organization converts the inventor's model into practical and usable products and places them on the market. This is often the most difficult job of all. Third, publicity for research or inventions is a necessary adjunct in making industrial research successful.

My present assignment is to cite some specific incidents wherein the human side of research has affected my own organization.

Research is a business and basically it can be compared with the usual manufacturing concerns. First of all it must have a managing head. Secondly, it usually requires a factory or a laboratory where machines and facilities are available for producing a product and third, but most important, it must have an adequate crew of trained personnel who have the brains and ability to make those machines operate. This then is a basic research organization. However, back of that there must be an industry or some other adequate reason for all of the research facilities.

In my own case this industry has to do with lumber and lumber products. It is an industry steeped in prejudices and outmoded practices. It is a proud industry in the knowledge that it has furnished comfort and shelter for every American for all time. It is an old industry that has been in existence for countless years and it is a new industry shaping its destiny to the mode of modern living. It is an industry where modernization is sometimes resented. These negative elements resent technical improvement and desire only that they be allowed to live in the past. But it is also an industry where there is even a larger and more important segment that believes in progress and has the will to bring this about.

Growth of Research

During the 19 years in which I have been connected with the National Lumber Manufacturers Association and the 13 preceding years in the employment of a large lumber manufacturing company, I have seen the seed of research planted, have watched it grow into a small delicate seedling which soon put on substantial annual growth rings. Today it is a vigorous sapling that is well thought of by its owners. It is true that the tree is still young, it needs fertilizers and the salable fruit from its branches may not be of great quantity, but as each year goes by the annual ring increases in girth. The fruit is large and luscious and in considerable demand. The seeds from the fruit of this tree are being put out in considerable numbers and except for an industrial calamity we can expect that in time the wood products industry will conduct research on a basis worthy of its record of past achievements.

Probably the most difficult phase of any research organizing is to get a reasonable start. I recall that less than 10 years ago a group of eight or ten people got together in a Cincinnati hotel and pledged a sum of $30,000.00 annually for a period of from three to five years; this money was earmarked for work in the field of hardwood research. In a sense these men were pioneers. It was one of the first successful attempts to organize research for the lumber industry on a national scale. Probably the thing that brought this organization into being was indirectly due to a process which had been developed for impregnating wood with chemicals. The process was advertised as making wood harder, resistant to decay, burnproof and dimensionally stable. The wide publicity, which from the technical standpoint was admittedly premature, nevertheless fired the imagination of the industry to such an extent that a few able men were willing to devote time and money toward technical investigations. Therefore, a piece of research which was from the start doomed to failure, had an important human influence in promoting a sound research program. I am most certainly not recommending that research should be prematurely exposed as being a complete and successful investigation nor that a mere laboratory phenomena be advertised as the savior of an industry, but I do want to point out that within reasonable limits the human mind has to be fired to the ignition point. Too often research people become so engrossed in technical details that they become annoyed with the mere mention of publicity.

Not so many years ago large timber structures could only be made by joining wood with mechanical devices. Because of this the structures were awkward, they were not economical in a modern sense and the size was limited by the accumulating effect of weak joints. Furthermore, the design of the structures was not flexible. Light weight streamlining with high strength could not be obtained by the usual methods of fastening. It is true that the art of gluing wood precedes the memory of man but satisfactory adhesives for modern purposes have only recently been accomplished.

A few years preceding World War II it became evident that if wood was to remain in the picture as a suitable shipbuilding material, it would be necessary to find ways for gluing small pieces together so as to make large, continuous, permanent structures. With the advent of urea glues it was believed that an adhesive suitable for this purpose had been made available. After much effort and persuasion, the Navy built several small boats using urea adhesives as a bonding agency. The boatbuilders were not entirely sold on the idea so for good measure they added a few bolts "just in case."

One of my most poignant memories is of the day when a call came in from the shipyard telling us that after six months of exposure in salt water the glue in the boats had entirely dissolved and that the vessels would have been on the bottom of Chesapeake Bay had the parts not also been bolted. This was a particularly sad story because by that time we had so convinced the Coast Guard of the practicability of gluing marine structures that two new Coast Guard vessels were designed for glued members. The construction of the boats was to start the day after we received the sad news. It seemed as though the world had fallen in because we knew that if we went to the Coast Guard with the story, the order would be countermanded and that our promotion job would go for naught.

I am sorry that it is not proper for me to mention names because I would like to give credit to a man who has never been given recognition for the role he played. Fortunately, one of our large glue concerns had been experimenting with a waterproof glue, one that could be used on large timbers and would not deteriorate in water. We didn't know what effect salt water might have on this glue but it seemed to offer possibilities. We were told that there was a barrel of the glue on hand. It was being used for experimental purposes and according to incomplete data it would do the job. With misgivings but much hope the two Coast Guard boats were built with the glue. I am happy to say that this adhesive with only slight modification became the standard for marine structures throughout World War II and is still much in use. Of all the millions of feet of laminated structures produced for the Navy and the Army during the war, there is no single instance of failure of the glue to perform. Call this luck, coincidence or just plain bullheadedness, the results are the same. From that small beginning the marine laminating program was assured. The results of marine laminating have spread to so many fields that it has now become the brightest spot in our present day wood utilization processes.

This is the story where the forces for good came together at the opportune moment to push a piece of important research across the line. I often wonder how many research projects have failed because they did not receive that one little push that is necessary to get them over the hump.

In our own organization we undertake from 100 to 150 research projects each year. Almost without exception whether the projects are large or small, there are periods in the project when it seems doomed to failure. About three years ago the Timber Engineering Company decided it would try to develop a new type of quick setting urea glue. The company had been selling an older type, the catalyst of which had a strong pungent odor and would also burn the user if it came in contact with the skin. Otherwise, the glue was successful and had been sold in limited volume. But in order to overcome the objections, we decided to develop a new catalyst that would overcome the faults of the older one. After the expenditure of some thousands of dollars, we came up with a catalyst which seemed to have the necessary properties. It didn't smell bad and wouldn't burn the skin even if stirred with the fingers. It gave satisfactory shear results when used on maple which is the standard species for testing glues. However, we required a glue which will work not only with maple but with all other species. When we tried it out on ponderosa pine and some other species, the results were very erratic. We tried to correct the situation in every known way but nothing seemed to help. We were about to give up the project as a bad job. However, our chief chemist suggested that we give it one more try by increasing the thickener in the catalyst. This was a simple thing to do and it now seems obvious that we should have done it before. With a few additional pennies spent on the project we were able to push it through to a successful conclusion and the wood products industry will shortly have a new, valuable adhesive that will make it possible to do things with wood that have never been done before. This achievement is entirely due to the tenacity and good judgment of one person who did not subscribe to the discouragement of others.

The director of research is frequently faced with the problem of determining when a project should be abandoned as being not worthwhile. If he gives up too easily, then nothing will have been accomplished for the money spent. On the other hand, if he continues in the face of all obstacles and eventually runs out of money without successful accomplishments, the reputation of the organization will suffer thereby.

The wood products industry greatly needs an economical process for stabilizing wood so that it will not shrink and swell. We have no more difficult problem than this. Most organizations with limited funds rightly steer clear of it because it is too complicated, expensive and non-productive of results. Our own organization conceived the idea that a satisfactory amount of stabilization might be obtained by using sonic vibrations to force chemicals into the wood. This project appealed to a large cross section of the industry but unfortunately only about a third of the funds requested was made available for the investigation. Nevertheless, the industry insisted it be carried on with the limited funds. At first we obtained favorable indications in our laboratory experiments but we did not have the money to properly equip ourselves to carry forward on a larger scale. Consequently, it was my decision, which should have been made earlier in the life of the project, that unless the industry was willing to subsidize the program with vastly larger sums of money, it should be abandoned. The piecemeal spending of a few dollars where the rapid expenditure of many dollars is called for is not conducive to good results. But it is a grave responsibility for the research director to make the decision to abandon research that has cost thousands of dollars when a few hundred additional dollars may bring it from failure to success. There is no more difficult decision to make.

I am firmly convinced that most research projects if thoroughly thought through before a start is made and then properly administed are very likely to succeed at least in part. For example, during the work on stabilization we partially developed a fine system for the nondestructive testing of wood. The process will sometime be of great advantage to the industry in that it will permit the testing of wood parts such as ladder rungs, scaffold planking, etc., on a go or non-go basis. Also the process should provide us with a method for determining when there are glue voids in plywood or laminated products. However, in general for a self-supporting laboratory that is working for an industry, minor or changed objectives are not very helpful. Usually only the objective which is originally set forth is satisfactory to the client. He has his own personal problem to solve and will not be satisfied with any answer that does not help him with it.

Strangely enough one of the most difficult of management problems is to train the staff to set down an objective and then pursue that objective to the end of the research. I am convinced that most technologists would rather be given a broad, general hint of what is wanted, an indeterminate but large sum of money and free scope to pursue the studies in any way that pleases them. This problem becomes serious when high priced men with a good reputation as scientists are put on the job. These people all too fre-

quently take it as a personal affront if they are required beforehand to put down an objective to which they must adhere. It is understandable that to them scientific achievement in any field or in any direction is satisfactory, but woe betide the research director who gets into this pitfall.

On the other end of the scale, the beginning technologist or even some of the older hands are incapable of setting forth an objective in clear, concise terms. Many otherwise fine technologists as they pursue the work become confused or actually forget the objective and are unable to pursue a project to a successful conclusion. There are occasions when common sense requires changes in the objective as the work progresses, but these changes should never be made without the consent of the client.

Probably one of the most difficult things to contend with in conducting research for an industry is due to the fact that research like any other business requires a particular understanding of that business. Unfortunately, in natural resource industries extensive research has been the exception rather than the rule. Very few of the executives in the industry understand what is required. They have seen from far off the rapid developments in the electronics field, the atomic field, in plastics, aluminum, etc., but they know only of the advertised successes and nothing of the discouragement and drudgery that attended the work. Most of them have never heard of the many failures and the many attempts that went haywire. They know in general that so many millions of dollars may have been spent on a particular project, but people with only slight understanding have the idea that all of the successes have been so planned and that there have been few failures.

Furthermore, it is seldom realized by the layman that research is only the first tool to the production of a better item. All too frequently a research project is authorized without sufficient thought being given by the client to his responsibility to put the results of satisfactory research into practical production. Unless he is experienced he does not realize that the research organization can go only so far and no farther. I believe that more promising developments have been forestalled by the inability of the client to utilize the information than there have been projects which failed in the laboratory.

Another factor which natural resources industries unfamiliar with research do not understand is that from the time a process is successfully developed in the laboratory until it can be utilized in practical production is usually of long duration. Therefore, because a laboratory process is not immediately used, it is often damned with faint praise, not because the technical people have fallen down on the job but because those who should make the products do not know that the time element between the experimental work and practical production is to a large extent the responsibility of the production departments.

About six years ago we undertook to develop a soil improver from waste wood. In the initial stages this process went along rapidly. Very fine materials were made and good results in growing plants in the improved soils were obtained. From that point on we needed large scale pilot production and extensive growth information. In our northern climate it takes almost a year to grow a plant. A few rabbits, a heavy downpour of rain or an exceptionally dry season may ruin the results of an entire year of investigation. Technical people understand these matters but the layman does not. Hence an extremely promising investigation has been unavoidably delayed. Delays of this kind can and sometimes do cause abandonment of a really fine project. The untrained client is apt to be optimistic without cause or to give up when conditions seem most favorable to the technologist.

Without doubt the human element is the most important ingredient in research, but there are some closely related factors that must also be given consideration. One of these is that industrial research will usually not be productive of practical results unless the development is timed so as to take advantage of suitable economic conditions. For example, during the war our industry was convinced that a development in wood sugar would result in the large utilization of waste wood. The economic conditions at that time seemed to warrant the modification of German processes to American conditions. Alcohol was selling for more than a dollar a gallon. Corn, other grains and molasses from which alcohol is usually made were in short supply and undoubtedly the unstable conditions at that time were momentarily suitable for the development. Unfortunately, it was not generally realized that the economic conditions would most certainly change after the end of the war and that unless something could be done to use the waste products, it would most assuredly not continue to be an economical process. Unfortunately, the large wood sugar plant which was constructed on the West Coast was built only for satisfying a war need. No one is particularly to blame for this because those who were charged with conducting the war were not responsibile for winning the peace or for developing products to be used during peacetimes, but on the other hand had our industry been sufficiently awake to its opportunity, additional usable materials might have been produced from the by-products to have assured the success of the wood sugar process. Eventually we will have favorable economic conditions whereby we can produce wood sugar. But most likely when that time comes, the present plant will be so far consumed by rust and decay that new facilities and new research will be needed. It will take strong men with strong convictions to overcome the prejudices that are the aftermath of this unfortunate venture. But America has such men and eventually success will attend the efforts.

In closing I would like to state that I am convinced that the technical progress of the wood using industry is solely dependent upon the training of young men in the fields of engineering, chemistry, wood technology and other subjects that have to do with research in wood. These men will be trained if industry insists upon it and provides the conditions for employing them. The equipment for the laboratories, pilot plants and other necessary things will be forthcoming automatically. We need not worry about this.

The principal job is to change the way of thinking of the people who presently administer our industry so that they will not view the industry of the future as a slight modification of our present plants and facilities. When the sawmill operators become thoroughly convinced that their operations must be integrated with that of the pulp and paper industry or that they will have to be partners in the production of wood sugar or producers of soil improvers or in any of the other hundreds of ways for utilizing waste wood, then and only then can we hope to compete successfully with other modern industries. Unfortunately, not all of the people who are manufacturing lumber are looking this far ahead. Like most human beings they are afraid of the unknown. They resist change because to change requires effort and a certain amount of risk. I personally have no fear that the trend toward modernization of the wood using industry will be stopped or that it will even be slowed up. The lumber industry has always produced a breed of men who have daring, who are intelligent, they have been among the principal organizers and builders of America.

Putting Research to Work[1]

K. G. CHESLEY
Director of Research, Crossett Lumber Co., Crossett, Arkansas

Much has been accomplished by research in the lumber industry, but we still have a long way to go. We must gain a better understanding of what research is, and how its results can be used in our industry and on specific jobs. Putting research to work must become everybody's job.

RESEARCH, TODAY, is a magic word. We may not understand it or know how to do it or even how to make use of it but we all believe in it. We know that if we have enough of it our nation can survive, our industry can stay prosperous, and our bodies can be cured of their aches and pains. We know that if we don't have enough of it our nation, our industry, and even we ourselves are in danger. We are convinced that the health of our industries depends on research. The lumber industry realizes that it is no exception and it is no longer necessary to sell the lumber industry on the value of research. We have seen what has happened to other industries and even to those segments of our own industry that have failed to keep up with the changing times. We know that research is something that we have to have if we are to survive. We are not in unanimous agreement, however, about how much research we need or about whose job it is to do this research for us.

There is a considerable volume of literature on the research expenditures of various industries. We are fairly well acquainted with the percentage of gross sales which is being spent on research in the different industries. Most of those in our own lumber industry are now convinced that the amount we are spending is pitifully meager in comparison with other competitive industries. We are in general agreement that something needs to be done to remedy this situation. There are, of course, some outstanding examples within the industry of concerns that have made a start in this direction. A few of our larger lumbering industries have built research laboratories and have set up research as an integral part of their operations. There seems to be little doubt that when such a laboratory is properly integrated it is the ideal way to bring the maximum benefits from research to an individual industry, Unfortunately, however, these few industries represent such a small percentage of the total lumber and wood products industries that we cannot look to them to solve all of the industry's problems. Several of the lumber associations are supporting fine laboratories and carrying on important work. Here again however, the total amount of money spent and the total research effort is only a small fraction of what is needed. Some concerns are supporting projects at research institutes and others are lending their support to the work of government laboratories. In spite of all these admirable activities, we still have a long way to go. We are confronted with the question of why it is that even though most of us are convinced of our need for research it is still difficult to get the wholehearted support from industry in getting a united, coordinated, adequate research program underway. There is no simple, single answer to this question. However, most of our difficulty appears to go back to the simple fact that while we believe in research, we have rather vague ideas about what research really is and we are even more confused about how we can use the results of research in our industry and in our specific jobs.

The plain and simple truth, which is often forgotten, is that a research laboratory—whether it be an industry laboratory or whether it be a research institute or a government laboratory—has never and will never make any improvement in the lumber industry or in any industry unless the results from that laboratory are put to practical use. Those who have charge of directing research programs are painfully aware of this truth. Many of those in our industry who are in management, production, and sales are not aware of this problem and have not realized that they themselves are largely responsible for the industry's not making better use of the results of research. To them, research has always been something that someone else does. They have not realized that the results from the research laboratory must go to work through them if it is to be of any value to industry. Moreover, they must necessarily play an active part in planning the research program from the very start so that when the results are obtained, they will know exactly how they want to use them.

Research to many people means a new machine, a new process, or a new product which someone else invents

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[1] Originally published December 15, 1952 issue of Southern Lumberman (Nashville, Tenn.)

and brings to them in its completed, final form. The plant superintendent and his associates are always anxious to install a new machine that the manufacturer can guarantee to make a better product or the same product at a lesser cost. The sales manager and all of his staff are anxious to sell any product if they know people who want to buy it. Management is not hesitant about investing money in any new product or process where it can be shown without a shadow of a doubt that the investment will return good dividends to the stockholders. Unfortunately, however, seldom if ever do such new machines, new processes, or new products come from a research laboratory in that sort of package. Therein lies the real problem. So long as management, production, and sales fail to realize that planning the program and, more especially, putting research to work is their own personal problem, the results from our research laboratories will not be fully utilized. Consequently, management and stockholders will not be eager to put more money into the laboratory part of the program. Until putting research to work is everybody's job, our industry will not make much progress.

The lumber industry is an old and honorable one. People have been making, selling, and using lumber for quite a long while. Not only did our fathers know how to saw down a tree and cut it up into board and build a house with these boards, even our grandfathers and their grandfathers knew how to do this. A study of the history of the lumber industry is of value only if it teaches us something about the future. The history of other old industries is interesting to read. One of these industries, which also had a part in making this nation great, was our fine network of canals. The following quotation relating to this industry is taken from McMaster's *History of the People of the United States*:

> Canals are facts; railroads are theories, and are opposed to the habits of our people. The farmer cannot own railroad wagons. But for a few hundred dollars he can buy a boat. Into his boat, the farmer can put an assorted cargo of flour, bacon, hemp, lumber and vegetables, draw it to market with his own horses, sell it at any village on the way and bring it back loaded with what he pleases. Does anybody suppose railroads will take on loads offered anywhere along the line? No, indeed! The farmer must haul them to the stopping places. Canals will carry livestock, hay, firewood, building boards and planks. Railroads cannot do this. What would be thought of a load of hay coming along a railroad? The sparks from a locomotive would set it on fire before the journey began. Canals are adapted for military purposes; railroads are not. Imagine a regiment of troops with baggage, provisions, ammunition, and camp equipage transported by railroad! By canal this can be done and the soldiers live and cook comfortably on the way. Snow will make the railroads impassable for weeks. Rain will wash earth over the rails which will take weeks to remove. If steam locomotives were used, it would be necessary to have water boiling stations every six or seven miles to furnish the engines with tanks of boiling water for a supply of cold water would stop the generation of steam and stop the train. In the mountains, the cold of winter is often so severe that an axe will break when struck against a tree. Would not rails snap under these conditions as a train passed over them?

We can all laugh at this because we know someone whose thinking today is just about on a par with that of the canal owners in 1850. The real truth is that in some ways most of us are just as ludicrous as the canal owners in our thinking and not until every industry and every person in a responsible position in management, research, production, and sales realizes this will we begin to make real progress. Each of us must accept our own share of the responsibility. Unless each of us is keeping abreast of new and improved ways of doing our job, unless each of us is changing and making progress, then we personally are a stumbling block in our own industry and until we accept our responsibility, progress will not come.

In spite of the fact that we still have a long way to go and that many in our industry are still waiting for someone else to do the research for them and to tell them how to solve their problems, we are making much progress and there are many hopeful signs. Mention has been made previously of trade associations' laboratories and of work done by individual concerns in their own laboratories, in government laboratories, or in privately supported research institutes. These are all steps in the right direction. Another hopeful sign is to be found in the fact that industry is bringing in young graduates in wood technology, engineering, and related sciences and making use of their knowledge. The growth and support of the Forest Products Research Society is another proof that many in the industry have recognized one of the important jobs that needs to be done and are working together to help solve some of the problems. The Forest Products Research Society was organized in 1947 for the purpose of gttting information on new developments, new products, new processes and new ideas to the people not only in research but in management, production, and sales. It is a technical society covering all phases of the lumber industry in which not only research but men from management, production, and sales are all cooperating to bring about the desired increase in support of research and the increased use of the results from research. The objectives of the Forest Products Research Society are simply to encourage and promote the efficient utilization of wood and other forest products in the broadest and most liberal manner by:

(a) Facilitating the interchange of information and ideas among individuals and organizations that are interested in forest products research, development, production, utilization, or distribution;

(b) Sponsoring meetings for the presentation and discussion of reports of investigations and experiences of its members and others;

(c) Publishing and distributing pertinent information;

(d) Promoting standard test methods and procedures;

(e) Encouraging acquaintanceships and cooperation among its members, and

(f) Carrying on related activities that further the objectives of the Society.

The growth of this organization to date and its accomplishments are indeed heartening.

Obviously, the Forest Products Research Society or any technical society cannot be expected to solve all of the problems of the forest product industries. However, membership in and support of such a technical society is the first and minimum duty of everyone who is concerned with the future of the industry. Many industries and individuals are putting a great deal of effort into the Society and are benefitting themselves and the industry thereby. This is one way that every person and every industry, no matter how small, can cooperate in a united effort to further research, to keep abreast of new developments, and to be a part of the growth of the industry.

The Veneer and Plywood Industry of Yugoslavia[1]

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Production of plywood and veneers in Yugoslavia is generally hampered by worn out or badly war damaged factories. One large, very modern plant is being constructed. Recognizing the importance of these industries to the national economy, the government is interested in their modernization. Consequently, it can be assumed that Yugoslavia will continue to be an important source of plywood for European and African markets.

YUGOSLAVIA HAS ALWAYS been primarily a supplier of rough and round forest products, including logs, rough lumber, mine props, railroad ties, poles, piling, posts, and fuelwood. The present trend, however, is to increase the amount of processing given timber resources and to supply more highly refined products. This leads naturally to increased interest in the production of veneer and plywood.

The veneer industry in Yugoslavia has a long history of producing a very high grade product. This industry is built around the exploitation of the Slavonian Oak or Summer Oak (Quercus pedunculata sallisb). This oak has qualities of color, texture and grade which make it one of the finest of the world's veneer woods. The veneer wood second in importance is Circassian Walnut (Juglans regia linn). This wood is also highly prized for its figure and color. Lesser quantities of ash (Fraxinus), elm (Ulmus), maple (Acer), and other hardwoods are also used. There are three large veneer slicing operations now in operation in Yugoslavia. They are located at Sremska Mitrovica in the Republic of Serbia and Slavonska Brod and Sisak in the Republic of Croatia. All are situated on the Sava river between Belgrade and Zagreb where they can tap the oak forests of the Croatian province of Slavonia. Another smaller veneer slicing operation is located near the town of St. Peter na Kras in the Republic of Slovenia. A fifth slicing installation is now under construction at Blazuj near Sarajevo in the Republic of Bosnia–Herzogovina.

Yugoslavia has four plywod factories in operation and a fifth under construction. One plywood plant is located at Sremska Mitrovica, two at the seaport of Rijeka (Fiume) in Croatia and a fourth at St. Peter na Kras. All of the plywood factories were built during the period between World War I and II. In common with most of the wood industries of Yugoslavia these factories were built with foreign capital. Following world war II the government of Yugoslavia expropriated these industrial properties. Since that time the plants have been operated by the Yugoslavians.

In addition to the four operating plywood factories, the Yugoslavian government is constructing a new veneer and plywood plant near Sarajevo. This factory is being erected at a cost of approximately $4,000,000.00 and when completed will be one of the largest and most modern in Europe. The enterprise will be an intigrated utilization unit including a face veneer slicing operation, a plywood plant and a hardboard factory. The plant is being equipped with the most modern German machinery. It has been financed largely through the assistance of the International Bank.

Timber Resources

The veneer industry requires very high grade oak logs as its primary raw material. There appears to be an adequate supply of large clear prime oak veneer logs to supply the industry for an indefinite period. It is currently government policy to favor the operation of forestry management practices which would insure a continuing supply of oak for veneer purposes. Yugoslavian foresters feel that the volume of veneer quality oak logs is decreasing very rapidly. However, large volumes of oak logs which would be considered prime veneer quality in most parts of the world are daily being converted into lumber at sawmills in Yugoslavia. Currently the emphasis seems to be on the production of such high value products as veneer and plywood rather than lumber and it can therefore be expected that in the future many of these good quality oak logs will be reserved for veneer. The walnut logs which are the second primary raw material of the veneer industry come largely from cultivated trees removed from orchards. This source would appear to be rather stable.

The raw material situation in the plywood industry is not nearly as rational as it is in the veneer industry. The two factories at Rijeka were located at that port because they were designed to utilize Okoume (Aucoumeaiklaineana, Pierre) logs from Africa. The port location was ideal from the standpoint of incoming log shipments and outgoing export plywood shipments. Since world war II these plants have been operated exclusively on domestic beech (Fagus sylvatica L.) logs. Since the factories were not built with this objective in mind, they are not located near the sources of veneer quality beech timber. Accordingly it is necessary to ship beech for distances up to 300 miles to keep these factories supplied with logs. The supply situation in-so-far-as the beech veneer logs is concerned appears to be similar to that of oak veneer logs. The quantity of high quality logs is decreasing but there are still large volume of beech logs being converted into lumber at sawmills that would be considered good veneer logs in most areas of the world. In the future many of these logs will probably find their way to the plywood factories instead of the sawmills.

One of the principal problems which the Yugoslavian plywood industry has to solve is that of log conservation between felling and delivery to the plant. Beech is a species that is subject to very serious end splitting when logs are permitted to dry out. Because the distance from the beech forests to the plywood factories is great and the transportation facilities poor, the time between felling and delivery to the factory may be as long as four or five months. As a consequence, many logs reach the plants in such poor condition that much of the volume is wasted and yield is extremely low. This is one of the most important problems which the Yugoslavian plywood industry has to solve. It is probable that this problem will be alleviated eventually by locating new factories nearer the log source as was done in constructing the new factory in Bosnia. It is also probable that at least one of the factories at Rijeka will be dismantled and erected near a source of beech logs in Croatia.

[1] Presented at meeting of Forest Products Research Society, Carolinas–Chesapeake Section, November 7, 1952 at Raleigh, N. C.

Manufacturing Facilities

As previously noted the four operating factories in Yugoslavia were constructed during the period between the two world wars.

The Yugoslavian veneer and plywood factories are equipped largely with German machinery. A few Swiss, Austrian and Scandanavian machines are also in evidence. Only one factory has any American machinery and that consists of a vertical slicer, rotary lathe, green clipper and roller dryer purchased second hand in 1937.

Equipment generally is in a poor state of repair. The two factories at Rijeka were repeatedly bombed and burned during the war. They were rebuilt after the war but damaged equipment was simply patched up rather than replaced. The factory in Serbia was burned by the Germans when they evacuated it. All of the veneer and plywood plants were used throughout the war and operated around the clock after the war as a contribution to rebuilding the war torn country and as a means of developing foreign exchange since veneer and plywood are among the country's most important export items. The heavy war damage plus the accelerated post war operations without replacement of damage and worn out machinery has resulted in an industry which is in a state of serious disrepair.

The equipment used by the Yugoslavian Plywood industry is generally similar to that used in the United States with some exceptions.

Veneer Cutting

Rotary veneer is cut on lathes mostly German Manufacture that are similar to American lathes. The more modern equipment appears to be comparable in quality and productivity to similar American machines. Behind the lathe the veneer is reeled by hand. The hand reeling methods are distinctly inferior to the storage deck or automatic reeling systems of handling employed by modern American hardwood plywood plants. In every plant the capacity of the lathe is limited by the inadequacy of the reeling equipment. Round-up is moved to separate clippers by very primitive hand methods. These methods of handling round-up result in much breakage and reduced yield. Sliced veneer is produced almost entirely on horizontal slicers. Of 11 slicers observed in operation only the single American machine was a vertical slicer. This old vertical slicer installed as a second-hand machine in 1937 outproduced the fastest horizontal slicer in a ratio of two and one half to one. The general opinion of veneer plant personnel in Yugoslavia is that horizontal slicers are more accurate than vertical slicers. Quality control charts set up by the writer covering several days production failed to confirm this opinion with regard to the machinery currently in use. It may be true with regard to new equipment.

Veneer Drying

Rotary cut veneer is dried in roller dryers similar to those used in this country. Sliced veneer is always air dried. The air dryers are large frame buildings with louvered walls equipped inside with wood frame drying racks. The sliced veneer is placed in the racks in bundles about one half inch thick. Usually small hot air heating units are available to boost drying during periods of high humidity and low temperature. The auxiliary heating units examined were poorly designed for the purpose. Veneer industry personnel indicated that the rate of drying was a function of the outside atmospheric conditions. The air dryers were said to be the bottlenecks in the sliced veneer industry. During the winter the inability of these dryers to rapidly dry veneer frequently results in curtailment or suspension of slicing operations. Two factories have racks in the open air for veneer drying. These are equipped with roofs but have no walls Only the lower quality thick veneer is dried in these open air dryers These air drying methods result in an excessive amount of waste and poor control of quality as compared to a good mechanical face veneer drying operation in the United States.

Preparation of Veneer for Gluing

In the preparation of veneers for gluing the Yugoslavian factories are doing very poor work. This is due almost entirely to the fact that jointers and splicers, almost without exception, are worn and damaged almost to the point of uselessness. The industry plans to replace this equipment and in fact, new splicers were delivered to the Mitrovica factory during 1952. All splicers were equipped with feed roll on the upper heads rather than feed chains and they did not work as well as splicers with chain feed above and below. Jointers were all of the traveling head type with head speeds and carriage travel speeds that were very low by American standards.

Lumber Core

Lumber core is produced in Yugoslavian factories from softwoods. The principal wood used is fir (Abies). In most factories lumber core is made by the block method. Rough lumber is cut into short clear pieces and laminated with casein glue into a block. The block is then put through a gang saw and cut into lumber cores. One factory built lumber core in a steam heated core press using clear strips about 1" x 1" square and in multiples of the panel length. End grain butt joints are regularly permitted in lumber cores. Generally the quality of Yugoslavian lumber core was very inferior to even the lowest quality American lumber core. This was a function of the processing methods used rather than the materials. There is considerable interest at all factories in the use of better core production methods.

Gluing

All panels are produced in hot presses. The standard glues used by the Yugoslavian plywood industry are casein and casein-blood blends. The industry is in the process of converting to the use of urea resin glues. Two factories are regularly using urea for part of their production and the other two are preparing to use it. The new factory is also planning to use resin at least for part of it's production. Where urea resin is used, blood is the standard extender. Edible grain flours are needed for food and are therefore not available for use as glue extenders.

The Yugoslavian plywood industry produces a substantial volume of beech aircraft plywood both for export and for domestic consumption. Phenolic film glue is used in aircraft plywood manufacture. All casein and synthetic resin glue currently used is being imported. A factory has been established in Zagreb to produce synthetic resin glues and it is probable that some urea and phenolic adhesives will be produced there for the plywood industry in the future.

All plywood factories are using metal roll casein spreaders. With conversion to synthetic resin glues, the industry will probably convert to more modern spreaders.

Finishing

Plywood is finished by drum sanding or scraping and most plants are equipped for both operations. The bulk of the plywood is sanded. The domestic market prefers sanded plywood to scraped plywood. The largest export market—Great Britian—also prefers sanded plywood. Other export markets, principally in southern Europe, North Africa and the near East, prefer scraped plywood.

Factory Organization and Operation

Immediately after the end of world war II the communist government of Yugoslavia expropriated private industry and commenced operating it under public ownership. During the period between the proclamation of the Federal Peoples Republic of Yugoslavia in November 1945 and the expulsion of Yugoslavia from the cominform in June 1948 industry was organized in the Russian pattern. Control was exercised from the top and the federal government in Belgrade designated the products a factory could produce, the prices it could charge, who it could sell its product to, what wages and salaries it could pay, etc. Following the break with the cominform countries and the rapproachement with the western countries the policy of the Yugoslavian government became one of decentralization of power. Many of the powers previously exercised by the federal government in Belgrade were transferred to the ministeries of Industry of the six republics making up the Yugoslavian nation; Serbia, Croatia, Slovenia, Montenegro, Bosnia-Herzogovina, and Macedonia. In each of these republics the Ministry of Industry included a Direction for the Wood Industry which exercised control over wood products industries including the veneer and plywood industry. In addition the factories themselves were given more autonomy. As of July 1 1952, the next step in decentralization took place. The strong control exercised by the Ministry of Industry in each Republic was transferred to the factories and the municipalities. The Direction for Wood Industry in each Republic was disbanded. In theory, control over each factory is now vested wholly in the workers in that factory. In many ways the organization resembles that of the cooperative Douglas Fir plywood factories. The workers in a plant elect a workers council which for a typical plywood plant might consist of 50 to 100 workers. This group corresponds roughly to a board of directors. The workers council elects a workers committee which functions similarly to an executive committee. This workers committee appoints a director who corresponds to a general manager.

Free Competition

Each enterprise can compete for business both domestic and export with other similar enterprises in the country. It sets its own prices, labor rates, salaries, etc. with some general limitations established by the federal and republic governments. The federal government still exercises a considerable amount of indirect power over industry through it's control over currency and foreign exchange, taxation and natural resources. All of the timber required for veneer and plywood operations is owned by the state and the price which the converting factories pay for it is fixed by the state. Since this cost represents between 50 to 75 percent of the total cost of finished plywood the government is thus able to exercise a powerful control over an enterprise's production cost. The direct taxes levied against an industrial enterprise are based upon the amount of money paid out in labor. The average Yugoslavian laborer earns approximately 300 dinars[1] per day. Wood industries such as plywood plants, sawmills, etc., are required to pay in taxes annually 1.67% of all money paid for labor in excess of 4,000,000 inar. Industries where the ratio of labor to capital investment is much higher than that of the wood industry are taxed at much higher percentages. A steam powered electric generating plant for example pays 1140% of labor above the fixed base and hydro electric plants more than 3000%. The government has exercised strict control over foreign exchange. Since all veneer and plywood machinery and virtually all glue is imported controls are very important to these industries.

Exports

In the past year these restrictions on foreign exchange have been relaxed somewhat and individual companies have more freedom. Currently any manufacturing enterprise whose product is sold in export can use freely 40% of the foreign currency which it earns. Since the veneer and plywood industry exports about half of it's production it is in a favorable position with respect to foreign exchange.

The veneer and plywood industry has a reasonable number of skilled laborers with long experience. For various reasons many of the management and supervisory personnel associated with the veneer and plywood factories prior to 1945 are no longer associated with these plants. Turnover among supervisors and managers since the war appears to have been very high. The current management is largely inexperienced. There is virtually no use made of such modern industrial management tools as quality control, production control, etc. In view of the inexperience of management these techniques need to be mastered.

Since labor is cheap it is used profusely and the man hours required to produce a thousand feet of hardwood plywood would be about twice that of an efficient southern hardwood plywood plant. Generally equipment is poorly arranged from the standpoint of material flow. Machines are operated individually on a job shop basis rather than as components of a production line. Inventories of work in process in the plywood factories are excessive by American standards.

[1] The present official rate of exchange is 300 Dinars to the dollar.

Summary

The Yugoslavian plywood industry is important to the national economy both as a source of foreign exchange and as a source of material for rebuilding the war torn country. The factories are worn out and badly damaged as a result of the war. The new factory now being constructed is very modern and there is every reason to anticipate that the others will be modernized in the near future. The industry has available to its excellent logs. Currently these are being converted into relatively low quality plywood largely because of the poor condition of the machinery is the factories. Labor costs are low and taxes very high. There is a reasonable supply of skilled labor and good technically trained wood technologists. Top management in the factories is inexperienced. The Yugoslavian government is interested in modernizing the country's veneer and plywood industry and as a consequence it is reasonable to assume that this south slav nation will continue to be an important source of plywood for the European and African markets.

WOOD PRODUCTS FIELD UNLIMITED

Wood and its products represent a field that is virtually unlimited, J. B. Faegre, president of Minnesota and Ontario Paper Co., told company supervisors at a recent meeting. Because wood fiber has so many uses the industries involved are bound to progress "under the pressure of civilization" and with the aid of technical improvements. Faegre noted that per capita consumption of wood fibre in U. S. is 439 pounds per capita per year, compared with 124 pounds in Britain, 72 pounds in continental Europe, and 17 pounds in Latin America.— Timber Producers Assn. Monthly Bulletin.

The European Chipcore Industry[1]

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Opinion is rather widespread that Europeans are further advanced than this country in the manufacturing and processing techniques for the production of dry formed particle boards. Study shows this is generally not the case. However, the splinter-type board would appear to have a much wider potential for cores than has so far been developed.

IN JUNE OF THIS YEAR, we had the privilege of touring Europe for the express purpose of investigating Chipcore manufacturing processes and the equipment used in these processes. It was deemed advisable to secure this information primarily because of the increased activity of sales agents for several European processes in this country.

Generally speaking, the proponents of these processes offer the know-how, engineering, and guarantee of protection against duplicate plants being sold in the immediate area. For these services, they charge about ten percent of the total plant cost but do not guarantee capacity or product.

Our survey leads us to believe that Europe is ahead of America only in total production. We question whether or not they lead us in technical information. The differences between American and European processes are the physical shape of the prepared chips and the extended resin formula. We do not feel that either of these differences indicate Europe to be farther advanced. The approximate selling price of Chipcore in this country is established by the prices of competing products, and since labor-wage rates are much higher here than in Europe we could not profitably operate a Chipcore plant in this country to European methods.

It is true that Novoply is manufactured by a European process and is produced in this country. But, Novoply is sold as an interior decorative panel at high prices. The greater market in this country is for core material which can be used in the construction of plywood panels. The sales price of Chipcore for core panels is controlled to a great extent by the price of poplar or gum lumber core.

There are approximately 15 plants in operation in Europe. These plants are located in France, Belgium, Switzerland, Germany, Sweden, and England. Our purpose is to give a brief outline of European plants and processes as we saw them and to compare them with plants and processes familiar to us in our country.

To indicate differences in European and American methods, a plant recently installed for a midwestern firm has been chosen as typically American. This plant requires approximately ten tons of solid wood waste per eight hour day, thus having a capacity of 8,000 square feet of 7/8 in. thick Chipcore at a density of about 32 pounds per cubic foot. The wood waste is kiln dried and typical of a woodworking operation. It produces a 1/4 in. phenolformaldehyde dry-resin-bound utility board as well as urea-formaldehyde liquid-resin-bound furniture-core stock.

The percentage resin treatments are similar to those used in Europe and to those recommended in bulletins published by various resin manufacturers in this country. The chips are of the splinter type produced by grinding lumber waste in swing-hammer shredders and screening to remove over- and under-sized material. Press conditions are similar to those used in both Europe and America with the actual forming pressure held to a minimum and with due consideration given to both fabricating quality and dimensional stability in the finished panel.

Continuous Process

The process is a continuous one, requiring seven men to operate the plant, starting with the grinder and concluding with the delivery of cured rough slabs to storage. Engineering design in this typical plant is an example of the attitude developed in American industry through healthy competition and high labor standards, leading toward the ultimate in mechanization with a minimum of labor. In the not-too-distant future, we believe that the production of Chipcore and related products will, in America, reach the same degree of efficiency as that in the paper and fiberboard industries. These statements on American ingenuity and practice are included here because it was evident to us that the most highly mechanized plants in Europe required more labor in keeping the too numerous gadgets in operating condition than would have been required if there were a few less gadgets in the system. We believe that the American industrial engineer is a little more practical concerning the extent to which he includes his labor-saving devices and coordinates these devices with speed of operation of the machines. Let us examine our findings, now, beginning with the Swedish Process.

Swedish Process

Several meetings were held with a Swedish engineer and his sales representative, which resulted in our obtaining the following general information; There is one small operation near Stockholm and a large plant of ten press openings under construction in Italy, which will use this process. The board appears to be satisfactory, although one of the least desirable of those made in Europe. The information we gained indicated that this process is similar to those used in the United States with the following exceptions:

(1) The logs used are de-barked by hand, mechanically or a combination of both, depending upon the end use. The chips are of the shavings type, the majority of which are approximately 1/64 in. thick, 5/16 in. wide and 3/8 in. long, as compared with our chips, which are generally of the splinter type, measuring approximately 1/8 in. in diameter and 3/4 in. long.

(2) Only the fines are removed. As a result, there is a rather wide range of chip sizes in the product. Judging from the samples we saw, the largest chips may measure 5/32 in. thick by 3/8 in. wide by 2 in. long. In this country, we remove both the under- and over-size chips for the

[1] Presented at meeting of the Forest Products Research Society, Carolinas–Chesapeake Section, November 7, 1952, at Raleigh, N. C.

purpose of maintaining a homogeneous or balanced product.

(3 A liquid-resin treatment is used at the rate of approximately 7% on the basis of resin solids, which is in line with that commonly used in the United States. However, one of the basic differences in the European processes as compared to ours is that they use a small quantity of starch as an extender, whereas we use wheat flour.

(4) The Swedish process, along with most other European processes, utilizes the cold pre-press to provide stability in the loose matted chips and to permit the use of a minimum of hot press daylight.

(5) The rough slab, which is cured to stops in the hot press is dressed by sanding. Two passes are generally required. Due to the shape and fragile nature of the shaving type of chip, planing is not practical.

German Processes

The most highly mechanized German Holzspanplatten (literally, wood-chip board) plant is the third erected by its owners. The first two, which were in the Russian Zone of Occupied Germany, had been confiscated. The capacity of the operation is 20 tons per 24-hour day, producing 4-ft. by 8-ft. panels in a ten-opening hot platen press. The principal products are wallboard, flooring, and furniture cores, ranging in specific gravity from 0.60 to 0.90 (37.4 to 56.1 pounds per cu. ft.). The low rate of production is due to the use of non-catalyzed urea resin requiring some 25 minutes per cycle for polymerization. The management estimated that the equipment in the plant would cost approximately $400,000.00. A general description of the process follows:

The raw material, as in most European operations, is clean debarked pulpwood, tops and branches. Great care in bark removal is necessary because large quantities of the product are used as wallboard. Panels having bark spots and othe defects caused by imperfections in the wood are sold as furniture core stock. The end use of the product, therefore, governs the degree of care required in debarking and whether or not hand cleaning must follow the mechanical debarker. Separate storage bins are maintained for the different grades of chips. Birch and spruce are the predominant species of wood.

The cleaned logs are fed by hand to chippers, which produce chips measuring approximately 1½ to 3 in. long, ¼ in. wide and 1/64 to 1/16 in. thick. The fines only are removed from the aggregate.

A rotary dryer reduces the moisture content to four to six percent. Then the chips are conveyed to storage and subsequently are metered into the treating system.

Continuous Mixing

The chips are discharged from storage at controlled rates to a continuous mixer. The mixer is a modification of a split flight-screw conveyor. The resin is metered to the mixer through spray nozzles. The treated-chip spreader, the design of which is unknown, apparently does a complete job of laying down a uniform mat without the necessity of auxiliary doctoring devices.

The cauls under the spreader and through the pre-press are made of ½ in. x 1 in. wood strips positioned perpendicular to the caul travel and banded together on the under side with several narrow strips of leather or canvas belting. At the leading edge of each caul, there is a 6 in. steel arm which contacts moving chain lugs at either side of the conveyor, providing movement of the cauls at controlled spacings and rates. The side walls of cauls are provided by means of belts on edge and moving up to a spacing conveyor at the speed of the cauls.

The operation could not be seen, but we were told that the mats are cross cut with a saw immediately after the cauls pass the spreader to permit separation of the individual caul loads by the spacing conveyor. The loaded cauls are taken into the pre-press by the spacing conveyor, the side walls of the press automatically move into position and then the press platen moves down onto the mat.

The pre-pressed mat is ejected from the press, transferred from the slat caul onto a rubber belt and then edge sawed. The mat moves into a machine whose purpose is to place the mat on the aluminum caul for hot pressing. This is accomplished as follows:

The mat moves onto a rubber belt in the machine. The belt then moves up until the mat is pressed against the aluminum caul, which is clamped firmly in position on a second belt conveyor. The machine (cyclindrical) then makes a 180 degree turn, placing the caul on the bottom. The caul then moves on to the press loading rack, or to an auxiliary rack. The auxiliary rack of five openings is located ahead of the press loader and is used as a buffer space in the event that trouble at the press interferes with the timing of the system. The press loader and unloader are very similar to some manufactured in this country. The cauls are pushed into the press and pulled out.

Press conditions vary with the end use of the product. Conditions typical for furniture-core stock would be as follows:

> 300 p.s.i. on surface area for 1.5 to 2.0 minutes; 150 to 170 p.s.i. for the balance of the curing cycle or for approximately 20 minutes; platen temperature—300 degrees F.

The initial pressure of 300 p.s.i. is employed for the purpose of reducing the total required time for curing.

After unloading, the cauls are returned automatically to the machine for loading the pre-pressed mats. The cured slabs are weighed and calipered and then passed through a steam-heated dryer. The slabs are hung by means of toggle clamps on an overhead power-driven trolley for movement through the dryer.

After drying, the board is trimmed and sanded to thickness in a three-drum sander. The sanding operation requires one to two passes per side.

Smaller Plants

Typical of the smaller, less elaborate plants is one having a production rate of approximately nine to ten tons per 24-hour day. The process is of the batch type throughout. We were told by the management that approximately 60 man-hours per 1,000 square feet were required in the operation through and including car loading. The principal products are furniture-core stock and wall board.

Spruce, birch, and pine logs and branches are purchased and hauled into the plant by company-owned trucks. De-barking is done entirely by hand. Five men are required for this operation. The green wood is fed by hand to four chippers, each having a capacity of 300 to 400 pounds of green chips per hour.

From the chippers, the material is pneumatically conveyed to a vibrating screen, fed to the dryer, and then over a second vibrating screen immediately following the dryer. Only the fines are removed at the screens. The moisture content of the chips leaving the dryer is controlled to from four to eight percent. Immediately out of the second screen, material is conveyed by belt to a large hopper, which discharges into automatic hopper scales, which are adjusted to handle sufficient chips for one mixer load. The weighed material is discharged into buckets which are gravity-conveyed by overhead trolleys to mixers and, completing the circle still by gravity, to a point near the filling station where they are automatically raised to the starting level for re-filling.

(Continued on page 78)

Observations on West German Furniture Production Methods in 1952[1]

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Although the details of the best American machines and production methods are known to some Germany furniture factories, their adaptation generally will be very slow unless there is some change in 1) the policy regarding the exchange of technical information, 2) corporation income taxation, and 3) union work restrictions. In much core production, German factories get 100 percent core yield from 1,000 square feet of one-inch straight edge lumber, and in hollow cores yield is upped to 200 to 300 percent.

DURING THE SUMMER of 1952, the writer was employed by a group of German furniture men as a consultant on various phases of furniture manufacturing problems. These men were the heads of fifteen furniture factories associated with over one hundred retail stores in a production and marketing organization called the "Musterring". The entire production of these factories is sold by the associated retail stores who have exclusive dealerships but also handle furniture lines produced by factories outside the Musterring organization.

The operating head of the Musterring is a furniture "architect" who designs all the Musterring furniture, does the advertising, arranges for furniture displays and Musterring meetings, and handles all sales contracts between the factories and retail stores. The cost for the services of the architect and his staff is considerably below the design and selling cost of American manufacturers. Through this organization, the manufacturers have their production firmly scheduled far enough in advance so the retail store trucks are usually waiting for the product when it reaches the shipping department. Although the writer spent the majority of his time working with the Musterring, he did do consulting in some other German woodworking plants and also visited a number of furniture factories in other European countries.

Eleven of the furniture factories visited in Germany are located in the province of Hannover, two are in the province of Hannover, two are in the city of Kaiserslautern, one is in Stuttgart, and one is in Cologne. In addition a one day survey was made of a parquet flooring factory in Bad Mergentheim. Four furniture factories were visited in England, four in France, three in Denmark and one in Austria. These factories visited included ones that made bedroom, dining room, living room, office furniture, novelty tables, radio cabinets and chairs. The factories varied from small shops to the largest furniture factory in the world as shown by the following list. Although the plants visited varied from very small through medium to large size, it should be noted that the average size is 225 employees. This is much larger than the average size European furniture factory. In these large factories, the production methods were better than in the smaller ones and were similar to the most efficient American factories.

Number of Employees	Number of Factories Visited
10	2
20	1
25	2
30	1
40	1
50	1
85	1
100	6
150	1
200	7
300	1
400	6
800	1
1200	1
4000	1
7410	33

The best German furniture factories are similar to some in the United States, but there are a number of differences between the industries of the two countries. The average size factory is smaller in Germany than in the United States. Since German labor costs only 40 cents per hour in United States currency and materials cost about the same in both countries, mechanical handling of materials is not as well developed in Germany. As power conveyors not only handle materials but also set the production pace, the rate of production is more intermittent in the German factories.

There does not appear to be as much plant layout planning in the average German factory as in the average American, although the best German factories seem to be very well arranged. The German factories spend more effort at material conservation than the Americans do. Except for one outstanding exception in England and one in France, the furniture factories visited in Austria, Denmark, England and France were not as efficient as the better factories in Germany. The balance of this paper reports on the procedures in German furniture factories although the observations do apply to most of the plants visited in the other European countries.

Lumber Procuring, Manufacturing and Seasoning

Some factories saw their own logs while others purchase lumber in log run grade or by individual grades, but taking the full run of the log. Logs are usually sawed on a Swedish gang type head rig and for better utilization are not edged. The usual procedure is to air dry the lumber full length keeping the boards from each log together, cut off to length, kiln dry, and then process through the factory. Only one factory observed kiln dries full length boards and then processes them through the mill. One factory saws logs, runs the green lumber through the rough end including rough band sawing, air seasons, kiln dries and then processes through the factory. Pine and spruce are generally used for lumber core stock and inside parts of case goods. Beech and oak are used for exposed parts although some walnut, mahogany, birch and other species are used in a few factories.

The methods and equipment used in seasoning are the same as in the United States, except that there is less mechanical handling in Germany. Lumber is usually hauled to the yard on carts and is well stacked on good piers with stickers between layers. When air dried to approximately 25% moisture content, the lumber is reloaded on carts, hauled to the cut off saw, cut to length and stacked on small kiln trucks with stickers between the layers. Except for relatively mild kiln schedules, there is no special

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effort made to prevent end checking which is not excessive. The kiln trucks are pushed into small size kilns usually built inside the factory. One reason for kiln drying after cutting off is to save kiln space, the tapered crooked, unedged full length lumber requiring much more kiln space than the same footage after it is cut off to length. In modern factories the kilns are reversible cross circulation with automatic controls. Some smaller factories stack on piers in the dry kiln and rehandle the lumber when it is dry. The lumber is usually dried to eight per cent moisture content. One factory visited is drying softwoods at high temperatures with superheated steam using a very fast schedule. Such dry kilns are specially constructed to withstand corrosion and excessive heat losses.

Veneer and Plywood Procurement and Manufacture

Before the last war most German furniture factories purchased all their veneers and some plywood. Now many manufacturers cut their own rotary veneers. The species used for most rotary veneers is called poplar by the Germans, but the trees and wood have characteristics similar to American cottonwood. Face veneers are cut by specialists and sold to the furniture factory from samples or after complete examination of whole flitches by the purchaser. Most face veneer is cut from importd logs but some domestic species are used. Face veneers are sliced 1/40 inch thick and are usually cut smoother than the 1/28 inch standard face veneer thickness of the United States. Rotary veneers for crossbands normally are cut 1/10 inch thick to cover up the very defective cores used.

Face veneers are cut to length, clipped to width and jointed, taped or spliced, patched and inspected in the same manner as in the United States. Fancy matched faces are frequently taped completely by hand rather than being processed through tape machine and clipper jointer operations. Interior plys and back veneers are cut on lathes from logs sawed to the length of veneers required. The "rounds ups" are clipped, dried, jointed and spliced or taped to required width. The continuous sheets of veneer are rolled on reels and then clipped to full width regardless of defects. The defects are cut out and plugged on a Raiman patching machine after the veneer is dried The larger factories use a continuous feed veneer dryer while the smaller plants stack the veneer on racks or on trucks with stickers and dry in a reversible cross circulation dry kiln. The machinery used is the veneer department is similar to the type used in the United States except that the German "Friz" tapeless splicer does not handle thin veneers nearly as well as the United States "Diehl".

German furniture plywood manufacture is characterized by constructions and procedures designed to economize on the use of materials. Thin plywood constructed from rotary veneers is made in the same manner as in the United States except that defects in the veneers are removed and patched with a Raiman patching machine rather than by clipping. Thick plywood panels are constructed in several different ways. A few factories glue up cores from ripped stock and plane them as we do in the United States. Most factories use a material or method which takes a smaller amount of good quality material. Chip cores are used by a large number of factories. The lumber yard of one furniture factory consists of split cordwood and the yard of another factory contains only tops, branches, leaves, needles and bark!

A large number of plants make a type of "blockboard" lumber core by gang ripping cut-to-length boards, turning the ripped pieces on edge, tying the core together with string, and gluing into regular five ply construction using 1/10 inch crossbands. Normally the only defects cross cut or ripped out are large open holes. 1000 square feet of one inch straight edge lumber will yield 1000 to 1350 square feet of lumber cores for making ¾ inch 5 ply plywood using 1/10 inch crossbands. The variation in yield depends upon whether the rough lumber is finish planned to ¾ inch, hit or miss planed to ⅞ inch, or left at one inch rough before gang ripping. The German yield of 100% compares with the usual American yield of 60% when producing cores from one inch lumber for ¾ inch 5 ply plywood using 1/24 inch crossbands.

The German cores are low grade with frequent open joints at the ends. Large open holes, large unsound knots or other similar defects are cut out and plugged with a Raiman patching machine. However, the finished plywood is of excellent quality and is equal to the United States furniture lumber core plywood after any open joints at the ends are repaired or the plywood is edge banded. A variation of this methods consists of the same general type of construction except that over 50% of the core material is left out making a 5 ply hollow core construction. Although this hollow core method takes more labor, the yield is stepped up to the range of 200% to 300% and the knot hole plugging operation is eliminated!

The equipment used in the gluing operations of German furniture factories is the equivalent of the equipment used in the United States. Both hot and cold pressing are used. The majority of the plywood is hot pressed in multi-opening presses using urea-formaldehyde resin adhesives. Some film glue is used on thin porous face veneers. Factories producing many models of curved veneered work in short runs operate a special press using fluid pressure with a rubber blanket and heat for curing. This process is faster and more efficient than the vacuum bag method. Veneer edge banding is done by hand with animal glue and also by air presses using electric resistance heaters with urea resin adhesives. There are as many minor variations in methods and equipment in the German factories as there are in the United States.

Rough Milling

The rough end departments of German furniture factories are designed for economic utilization of materials rather than high production. Conveyors were noted in only one rough end out of thirty factories visited. When defects are cut out much care is taken in the selection of lumber. A number of factories mark the cross cutting and ripping lines with chalk on each board before any machine operations are started. However, core stock is usually cut off without removing defects and gang ripped into core strips ready for core assembly.

The kiln drying operation is usually located between the cut off saw and the rest of the department. Where high quality cores are desired, the kiln dried cut-to-length lumber is face jointed and planed before gang ripping but this is not done when low cost and high yield are desired. Solid parts are usually jointed before being sent to the moulder or being processed further through the factory.

The equipment used in the German rough mills is similar to the type used in the low production type of factories in the United States. There are cut off saws, hand jointers, finger type power feed jointers, single planers, straight line rip saws, gang rip saws, variety saws, and bandsaws. The cut off saws are hand operated and only one rough end conveyor was seen. There are some clamp carriers for gluing and an automatic sizing continuous feed edge gluing machine was being installed in one German factory.

The larger plants which have moulders locate them either in the rough end or in the finish end machine room. Band saws are used for ripping in some plants to save waste due to excessive saw kerf. Except for a few machines, most of the German equipment does not appear to be as heavy and rugged as the equivalent American type.

Finish End Machining

The finish end machine room operations in Germany are very similar to those in the United States. Most standard German machines are hand fed. However, in the progressive plants there is a very large use of power feed attachments similar to Ekstrom Carlson's. All power fed machines operate at much slower feed rates than do the equivalent machines in the United States. Automatic shapers and automatic feed boring machines are seldom used. The smaller plants use a single spindle hand shaper for cutting straight and curved molded edges while the larger plants use a four sided moulder for cutting profiles along straight edges. Only the larger factories use continuous feed panel sizers and double end tenon machines. Since mortise and tenon joints are not usual for case goods construction, multiple mortise machines are not in use.

The quality of machined surfaces is very good, but extreme accuracy is not necessary in most operations because parts are cut slightly oversize to allow hand fitting in assembly. The saws and cutters used in the German factories are similar to those used in the United States. The German saw blades tend to be of narrower gauge when performing equivalent operations. The "cut control" saw blade is used frequently. Most knives are high speed steel, although some carbon steel is still used and tungsten-carbide knives and saw tips are being used in a number of factories. Many milled to pattern cutters are used. German grinding equipment is similar to ours.

On the average the volume of production per man hour and per machine in the better American furniture factories is much higher than in the better German factories. However, the production efficiency of a number of operations in some of their larger plants is the equal to or superior to anything the writer has seen in the United States. One large factory built their own equipment to perform all the machine operations on drawer fronts at a high feed rate with only one operator. Another factory built a continuous feed double end tenon machine which cuts tenons on *four* sides and returns the completed work to the operator.

One chair factory plans its machining operations so that the man tailing one machine frequently feeds the following operation. Some parts have four successive machining and sanding operations performed in this manner. The large machines have permanent locations in the factory while the smaller machines are moved when the production run is long enough to warrant the successive operation setup. The moveable machines have "plug in" electrical connections and flexible blowpipes for connecting to the main dust collection system. These illustrations are given to show that the best European plants have production machining methods fully equal to those of the United States furniture factories.

Sanding

With some notable exceptions, there is less machine sanding done in German furniture factories than in American. Since face veneers are usually 1/40 inch thick, extreme care is taken to avoid cutting through the face veneer near the corners of the plywood panels. The following sanding machines are similar to and are used in the same manner as the American: Multiple drum endless bed, hand block horizontal bolt, semi-automatic stroke, and edge belt. Most mould sanding is done by hand. Of eighteen factories doing mould sanding only one was belt sanding, using a formed block with a cloth backed abrasive for straight work. Not one was doing spindle sanding with a profile form for curved work. Glue sizing between sanding operations is the exception rather than the rule. Since the wood is machine sanded fewer times in Germany, the grit sizes are coarser than the sizes used in the United States and the parts are always hand sanded before finishing.

Assembling

The assembly of furniture is now in a transition stage in Germany. Until very recently, both the large and small firms assembled case goods with hand clamps in small lots with one or two men doing all the work on a lot, including subassembly, major assembly, edge banding, door and drawer fitting, trimming and hand sanding. Most factories still use this old procedure but some of the larger firms have recently installed complete assembly lines. Sub-assemblies are made in air presses with high frequency gluing, the case clamp is air operated with high frequency gluing. The fitting and trimming operations are done by separate men on a line where the cases are slid from one operation to another.

One plant reduced the labor on the assembly of bedroom cases from forty men to twenty men when they changed to the new method during the summer of 1952. The German design of cases is very well suited for high frequency assembly gluing. Self jigging dowel and mortise and tenon joints are not used. These cases are made similar to our radio cabinets. Many parts are assembled by applying glue, positioning the parts by eye, and carefully clamping together with hand screw clamps. Such a design can be mass produced economically with high frequency gluing easier than by any other method.

Other Developments

One radio cabinet factory assembles with high frequency or electrical resistance heating only. Panels usually are edge banded with veneer by skilled craftsmen using hide glue and a rubbed joint. Recently, a number of factories have begun to use air presses and electric resistance heaters for this operation. Hand power tools are just beginning to become popular. The more progressive factories use electric or air powered hand drills, screw drivers and sanders. Many plants still do all this work by hands. The assembly men are skilled cabinet makers who have served their apprenticeship. Parts are usually cut over size and are hand worked for perfect joints and fits. The German cabinet work is much superior to the usual American standard.

Both the chair factories visited by the writer were large and efficient. Their procedures can not be considered average for Germany or for any part of Europe, but some of their methods may be of interest to Americans. One factory does all the assembly work with mechanical powered or air operated clamps similar to the best factories in the United States. Certain designs of bentwood chairs are assembled, drilled, and screwed in an air clamp in the shortest time the writer has ever observed.

A motion study was made of this operation and a system put into effect where there is practically no lost motion and both hands of the operator are working equally. An overhead suspended motor with a long knuckle jointed thin shaft supplied the power for the drilling and screwing operations. The screwing and drilling bits were changed while the operator moved from one hole to another with no loss of time. A study by this com-

pany showed that this system was quicker than a combination of electric or air drills and screw drivers.

The other chair factory uses a system of machining and assembly that is entirely different from the conventional. Green lumber from the saw mill is sent to the rough end where the boards are cut to length and width and rough band sawing is completed. Next, the parts are air dried and kiln dried. The joints are then machined and the parts are glued together with mechanical power or air clamps into sub-assemblies or main assemblies. These assemblies are machined in special automatic shapers built by the chair factory itself. This method produces perfect fitting joints but creates some difficulty in machine sanding because of the large assemblies which are difficult to handle. An analysis of the relative efficiency of this unusual method compared with the conventional is left to the reader of this paper.

Finishing

In Germany most factories apply only a few coats of finishing material; and the finishing room is small with no conveyors or ovens. Part and sometimes all of the coats are applied by brush instead of spray gun. The cheapest furniture is finished in natural color with one coat of lacquer type sealer, and sanded, and followed by one coat of nitro-cellulose lacquer. A slightly better finish consists of a stain, sealer, sanding, two coats of lacquer and light rubbing with steel wool. The expensive German finish consists of a stain, washcoat, sanding, filler (optional), sealer, sanding, two to three coats of lacquer and rubbing. Rubbing usually consists of a tedious "pull over" process where the final finish is padded in and hand rubbed to a high polish.

A few factories cut down a thick lacquer film with a steel blade called a "zie-klinger" and then machine polish with compound to obtain a mirror like finish. The German finish on cheap furniture is lower in price and has a lower standard of quality while the finish on expensive furniture is higher in price and has a higher standard of quality than comparable furniture in the United States.

The German finishing materials are usually formulated much simpler than the American. A typical German filler consists of one ground material such as silica with one carrier such as linseed oil or lacquer thinner. American fillers contain many ingredients. A German nitro-cellulose lacquer might consist of nine ingredients while an American lacquer might contain twenty ingredients. It is very difficult to do a complete filling job with a German filler. American lacquers appear to have better working characteristics than German. Non-grain raising stains are seldom used because of the much higher cost than water stains. The rubbing material used for "padding in" is of high viscosity and apparently is made from shellac or lacquer as the solid material with slow lacquer thinner as the solvent. Hot lacquers and urea-alkyd resin varnishes are just beginning to be used in Germany.

The production procedures and equipment in the finishing department of German furniture factories are gradually being changed to be more like the American. All operations are influenced by the cost of labor compared with the cost of materials. German lacquer costs 25 per cent to 50 per cent more while German labor costs 60 per cent to 75 per cent less than American. Because of the higher cost of materials and lower cost of labor, it is still cheaper to apply all finish coats to most styles of chairs by dipping or brushing. In the past most case goods were also finished by brushing, but the majority of plants have now changed to spray gun operation for top coats and some plants apply sealer and washcoat by spray gun. Stain and filler are still applied by brushing or dipping. Spraying equipment is similar to ours. For instance, the DiVilbis Company produces the same items with the same model numbers in their Berlin factory.

The German factories are beginning to use electric and pneumatic powered hand sanding and rubbing machines. Only the larger plants are beginning to install conveyors and drying ovens. One each of the following type were seen by the writer: floor type platform, floor type wire mesh, belt, and floor type slat. Some of the larger plants use mechanical circular motion rubbing machines to help speed up the "padding in" operation, but it is still much slower than the American method of cutting down with fine sandpaper and polishing with a rubbing compound. The two finishing problems of German furniture manufacturers are: to improve the quality of the low price unrubbed finish without much increase in cost and to lower the cost of the high price high polish furniture without much change in appearance.

Packing and Shipping

Most German furniture is shipped uncrated in padded trucks and truck trailers directly from the factory to the retail store. Some companies have their own small padded box car bodies which are loaded in the same manner as trucks and can be taken from the railroad flat car and moved on a truck to the retail store. Some chairs are wrapped in pads or paper only and some knock down furniture is shipped in cartons. Since the area of West Germany is small compared with the United States and most furniture is shipped uncrated, the German packing and shipping operation is very simple compared with the problem in our country.

Production Planning and Control

The smaller factories in Germany appear to have no formal system of production planning and control but the larger factories are very well organized for handling this problem. Most large furniture factories have standard times set for all operations so that production orders are scheduled through the plant in considerable detail. Most large factories pay wage incentives based upon the workers exceeding the standard times. One factory schedules machine loads for all key machines and even changes the location of machines for a production order if the standard time indicates that the material handling saving exceeds the cost of moving the machines. The companies with good production planning and control usually employ a system of cost accounting to help control their operations.

Quality Control

In most German factories quality control is an integral part of production rather than a separate function. Skilled craftsmen are expected to machine and assemble parts according to company standards as explained verbally by the foremen. Frequently, the assembly foreman inspects each piece of completed furniture "in the white" and signs his name to the back of the piece before it is delivered to the finishing department. The inspection of finished furniture is usually the responsibility of the finishing department foreman.

The larger companies are just beginning to consider quality control as a distinct function that possibly might be put into operation separate from production. Although the inspection of parts and assemblies throughout the plant probably will still remain under the control of the production department, the trend appears to be to put the acceptance of the finished product under the control of sales.

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Lumber and Log Grade Yields From Second Growth Northern Hardwoods[1]

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Although foresters know many methods for improving the rate of growth, the quality of timber in a stand, or both, when demand for products developed from marginal trees are small the financial feasibility of practicing forestry becomes doubtful. Second growth hardwoods in northern Wisconsin present such an utilization problem. Knowing which practices are now economically sound and finding new use for materials not now marketable is important to sound forest management.

NEW USES for forest products, if they permit utilization of smaller or more defective materials than can now be marketed, are of great interest and importance to forest managers. Foresters know many methods for improving the rate of growth, the quality of timber or both, but if there is only a limited demand for all the products of the forest, the financial feasibility of practicing forestry is poor and timber yields likely to be low.

The second growth hardwoods of northern Wisconsin present such a utilization problem. There are about 1½ million acres of second growth northern hardwoods in Wisconsin. Most of this area has been cut since 1900. Typical second growth hardwood stands are composed of three distinct groups: (1) residual trees from the original merchantable stands that were considered to be too defective for use at the time of logging; (2) trees that were too small to be merchantable at the time of logging; and (3) trees that have seeded in since cutting took place. (Figures 1 and 2)

Now, some 50 years after logging, foresters called upon to manage such stands of timber are confronted with a most difficult silvicultural situation. The oldest age class in the stand is composed of 150 year old inferior or cull trees, making no net growth and suppressing and deforming the rest of the trees in the stand. Occasionally a merchantable log may be cut from the upper part of the stem, but the usable net volume of a typical tree is seldom more than 20 percent of the gross scale.

The middle age group frequently consists of trees 12 to 18 inches in d.b.h. and 60 to 70 feet in height. Thirty to fifty years after logging, this group contains almost all the merchantable volume in the stand. Some of these trees are of good vigor and form and can be expected to produce high quality sawlogs or veneer logs in the future. But often trees in this group are defective because of old logging injuries, sunscald caused by severe exposure after the original cut, animal and insect damage and decay.

The third and youngest age group, made up of trees from five to 13 inches in d.b.h. and 40 to 60 feet in height is the potential source of high grade timber in the future. The trees in the first two age groups may be suppressing and deforming those in this class. There are usually many individuals in this group that are already deformed or of inferior species.

Improvement Cut Aims

From the silvicultural standpoint, it is desirable to make improvement cuts in these stands as soon as possible. The aim of these cuts should be to better the stand quality and increase the rate of growth by:

1. Removing the cull trees as rapidly as possible without creating excessively large openings that might lead to undesirable suckering or sprouting on the main stems of the residual trees.

2. Reduce the poor growing stock in favor of well-formed, thrifty trees in the understory and codominant stand.

3. Thinning thick patches of pole sized trees, five inches to 10 inches d.b.h. to improve their growth and vigor.

These operations, however, are very costly and unless there is a margin of profit, are generally not undertaken. Determination of the break-even point for such improvement cuttings depends to a very large extent on making a reliable estimate of probable lumber values that logs of various grades will yield. It was with this objective in mind that the Lake States Forest Experiment Station initiated a study of lumber and log grade yields on second growth cut over stands in northern Wisconsin.

How the Study Was Made

On the Argonne Experiment Forest near Hiles, Wisconsin, three 20–acre blocks of second growth hardwoods were selected. The timber on these blocks were marked for an improvement cut. The area was then logged. All the logs produced on each block were kept separate at the mill until the lumber grade recovery study started. During the course of the study, no logs other than those from the study area were sawn.

A circular mill with a capacity of 15 M. board feet of lumber per eight hour day was used in the study. This mill was selected as being representative of the type of a sawmill that could be expected to utilize the kind of logs produced.

The logs were scaled, graded, using the grade rules developed by the Forest Products Laboratory,[3] and numbered on the log deck. The log number was transferred to each board as it was cut. For each log, these boards were graded and tallied on the green chain by log number. These data were later tabulated by logs and analyzed to show:

1.) The quality and value of lumber produced from the logs by species.

2.) To what extent it was feasible to predict the quality and value of

[1] Presented at meeting of Forest Products Research Society, Upper Midwest Section, Wausau, Wis., Dec. 9, 1952.

[2] Maintained by the U. S. Department of Agriculture, Forest Service in cooperation with the University of Minnesota at St. Paul, Minnesota.

[3] Hardwood log grades for standard lumber. Proposals and Results. March 1949. No. D1737. Forest Products Laboratory, Madison, Wisconsin.

Figure 1.—A defective yellow birch tree, being cut on the Argonne Experimental Forest, is typical of the trees that were considered too defective for use 45 to 50 years ago.

Figure 2.—Young, defective tree being cut on the Argonne Experimental Forest. This tree was too small to be merchantable 50 years ago. (Photo courtesy J. Botsford, Rhinelander, Wis., Daily News.)

lumber produced by using the log grades and lumber grade recovery tables developed by the Forest Products Laboratory in 1949[1].

3). To what extent it would be economically feasible to make improvement cuts in second growth northern hardwood stands of the type described under existing market conditions.

Analysis of the Data

The logging operation produced 1120 hardwood logs. The definition of a merchantable log required that such a log be at least eight feet in length, at least eight inches in diameter inside the bark at the small end, and after deduction for defect scale at least one third of the gross scale of the log. On this basis, 991, or 89 percent of the logs, met the merchantibility standard for hardwood sawlogs.

In addition, 81, or seven percent, of the logs were below the minimum top diameter and were classified as "submerchantable logs." Then 48, or four percent, of the logs were designated as "culls" because they had a net volume of less than one third of the gross scale. From the 1,120 logs, 49,000 board feet of green hardwood lumber were produced. Most of this volume, 94 percent, was from merchantable logs.

In general, the logs were small when compared with those usually obtained from mature timber. The average top diameter of all logs was 10 inches, with the merchantable logs averaging 11 inches, the submerchantable logs seven inches and the cull logs 12 inches. Sugar maple and yellow birch accounted for 85 percent of the lumber volume.

The value of the lumber cut from merchantable logs was sufficiently high to be comparable to lumber produced from old growth stands. Based on price quotations current in the fall of 1949, the sugar maple yielded lumber worth $70.55 per thousand board feet, and yellow birch, lumber worth $92.55 per thousand board feet. (Table 1). The average value of lumber for all species and for the entire cut was $77.16 per thousand board feet.

The value of the lumber from the submerchantable logs presents an entirely different picture. It was extremely low in all cases. The value of lumber from submerchantable sugar maple logs was $23.50 less than that from the merchantable logs; for yellow birch it was $46.80 less than the lumber from merchantable logs. For the entire cut the lumber from the submerchantable logs was worth $26.00 per thousand board feet less than that from merchantable logs. In addition, these small logs were more expensive to log and mill per unit of volume. Indications were that an eight inch hardwood log is the minimum size that can be handled profitably for hardwood lumber. Other uses must be found for the small logs or they must be left in the woods.

Surprising as it may seem, cull logs yielded lumber nearly as valuable as that of the merchantable logs. Only three species of cull logs were sawn, sugar maple, yellow birch, and basswood. The sugar maple culls produced lumber worth only $5.40 per thousand board feet less than the merchantable logs. Yellow birch culls gave lumber worth only $1.10 per thousand less than the merchantable logs. The cull basswood logs yielded lumber worth $34.75 per thousand less than the merchantable logs of the same species. Only three basswood logs were sawn so the data on this species is inconclusive. The cull logs have a relatively high value largely because their defect occurs in the heart of the log where the low grades of lumber normally occur. Except for the

Table 1—VALUE OF LUMBER BY LOG CLASSES FOR THE THREE MAJOR SPECIES (SECOND-GROWTH NORTHERN HARDWOODS)

Log Class	Lumber Value per M bd. ft.		
	Sugar maple Dollars	Yellow birch Dollars	Basswood Dollars
Merchantable	70.55	92.55	86.89
Submerchantable	47.00	45.74	69.08
Cull	65.12	91.42	52.14
Average	69.77	91.49	83.77

Table 2—PROPORTION OF THE TOTAL VOLUME OF LUMBER CUT IN GRADES NO. 1 COMMON AND BETTER FOR THREE SPECIES (SECOND-GROWTH NORTHERN HARDWOODS)

Log Class	Proportion of Lumber Cut in First Three Grades[1]		
	Sugar maple Percent	Yellow birch Percent	Basswood Percent
Merchantable	21.6	33.7	37.3
Submerchantable	2.4	1.0	12.5
Cull	20.5	34.09	6.8

[1]Firsts and Seconds, Selects, and No. 1 Common.

fact that cull logs are expensive to log and mill they should not be looked on with disfavor when considering lumber values.

The merchantable logs of all species except black cherry, elm, and ironwood yielded 20 percent or more No. 1 common or better lumber.[1] White ash gave the highest yield with 64 percent of the lumber being No. 1 common or better, basswood was second with 37 percent in the upper three grades; yellow birch and paper birch yielded 34 percent and 33 percent respectively. Sugar maple and red maple yielded respectively 22 percent and 20 percent of No. 1 common and better grades.

Lumber grade yield of the submerchantable logs of all species was very poor as expected. Only basswood and ironwood gave more than 10 percent No. 1 common and better. All other species gave less than five percent of the first three grades.

Both sugar maple and yellow birch cull logs yielded about the same percent of the higher grades as did the merchantable logs for the same species.

Applicability of Forest Products Laboratory Log Grades to Second Growth Hardwoods

One of the major aims of the study was to determine whether the hardwood log grades developed by the Forest Products Laboratory at Madison, Wisconsin, successfully predict the lumber values obtained from second growth hardwoods in Wisconsin. Since only two species, sugar maple and yellow birch had sufficient volume in all three log grades to form a basis for comparison, the test was made on these species only. Data developed by the Forest Products Laboratory show what lumber grade yields are to be expected from each log grade. Using these yields as "estimates" and the tallies by lumber and log grades as "actual" it is possible to evaluate the F. P. L. log grades. Some of the most significant findings follow:

1. There is considerable error between the "estimate" and the "actual" lumber grade recovery for each log grade. With the exception of log grade No. 1, the estimate of lumber yield for sugar maple was too low in the first two grades and too high in No. 1 and No. 2 common lumber grades. The percentage of 3B common lumber was underestimated for all log grades in sugar maple and overestimated for all log grades of yellow birch.

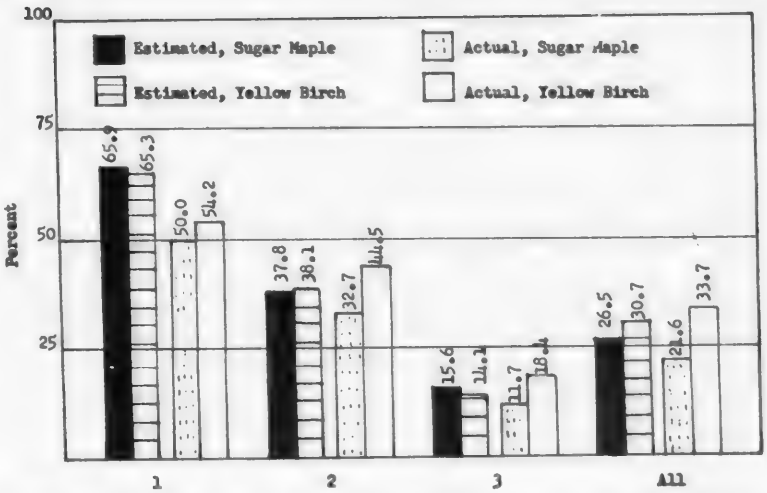

Figure 3.—Estimated and actual percentage of lumber in the first three lumber grades.

2. When the estimate of the percentage of lumber in the first three lumber grades is compared with the actual cut in these lumber grades it is found that the estimate is too high in all log grades for sugar maple: 16 percent high in log grade 1, five percent high in log grade 2, and four percent high in log grade 3. For yellow birch the estimate is 11 percent high in log grade 1, six percent low in log grade 2, and four percent low in log grade 3. (Figure 3.)

However, the estimate of the percentage of lumber in the first three lumber grades for the entire cut was very close for both species. Sugar maple was overestimated by five percent and yellow birch was underestimated by three percent.

3. These errors tended to balance out when the values of the lumber grades were taken into account. The estimate of the value per thousand board feet of lumber for the total cut of both sugar maple and yellow birch was within ten percent of the actual value. This is sufficiently close so that the Forest Product Laboratory Log grading system can be said to apply satisfactorily on a value basis to the total cut on this area of second growth hardwoods in northern Wisconsin.

Cost and Returns

Records of logging and milling costs were kept for the entire operation. Selling prices were determined from current lumber prices at the time of milling. The cost of logging and milling cull and submerchantable logs was not kept separate from the costs on merchantable logs. However, the differences between costs and returns was sufficient so that the operation as a whole was profitable (Table 3).

Summary

Briefly, the study points out the following:

1) The log grade rules and recovery tables developed by the Forest Products Laboratory, primarily for old growth hardwoods apply satisfactorily on a value basis to the total lumber recovery in second growth hardwoods in Wisconsin. It is doubtful that the variation within and between log grades could be modified by further refinements in the log grade rules,

(Continued on page 79)

Table 3—COSTS AND RETURNS FOR TOTAL CUT (INCLUDES CULL AND SUBMERCHANTABLE LOGS) (SECOND-GROWTH NORTHERN HARDWOODS)

Species	Costs and Returns per M bd. ft. Lumber Tally						
	Logging Cost	Milling Cost	Selling[1] Cost	Total Cost f.o.b. Mill	Selling Price	Margin for Profit, Risk and Stumpage	Indicated Stumpage with a Profit Ratio of 10.
	$	$	$	$	$	$	$
Sugar Maple	25.23	24.43	3.49	53.15	69.77	16.62	10.28
Yellow Birch	25.80	24.43	4.57	54.80	91.49	36.69	28.37
All Hardwood Species—Weighted	25.65	24.43	3.82	53.90	76.31	22.41	15.47

[1]Estimated as five percent of selling price.

A New Round-Log Gangsaw For Small Mills[1]

PAUL R. KRAMER
Texas Forest Service, Lufkin, Texas

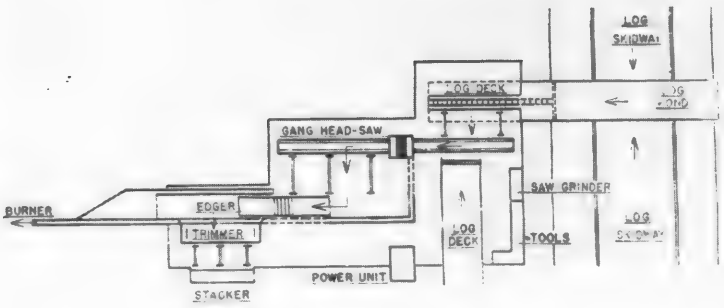

Figure 1.—Flow-line diagram for small gang-mill operating in Southern Pine area.

This round-log gang mill helps make small operation more efficient by permitting smaller green board thickness, reduced saw kerf, greater average lumber length, and reduced amounts of slabs. Uniform sawing reduces sawyer error. At mill studied, rough, green lumber tally exceeded net log scale by eight percent.

ROUND-LOG GANGSAWS have never been particularly common in the southern pine area. However, recent improvements in gangsaw equipment have started a trend that may well lead to an expanded use of this type of headsaw. This conclusion is justified on the basis of two facts: (a) several installations of this nature have been made in the South, and (b) these mills have been so modified that they are exceptionally well adapted to the sawing of small-diameter, crooked, pine logs. Since this type of headsaw seems to hold considerable promise in our future utilization picture, let us examine in some detail an operating installation which uses one of these modified, round-log gangsaws.

The specific operation is that of the Livingston Wood Products Company at Livingston, Texas. Their production is entirely pine and averages about 15,000 board feet of 4/4 lumber per day from small to average size logs. In other words, this is a small mill. However, there are so many interesting features to this mill other than the gang-headsaw, that it drives home the fact that small mills can operate under highly efficient methods. This is of considerable importance since labor and material costs are now spotlighting the need for mill efficiency.

This operator has provided his mill with the support of a dry kiln and finishing department. Thus he retains ownership of his product through as many processing stages as possible, so as to provide the maximum return for his investment in the original stumpage or logs. There are also other points throughout this mill operation that clearly indicate that small mills can operate efficiently under big-mill flow-line techniques. These are not necessarily represented by costly equipment installations but rather by careful planning and prudent modification of machinery and methods.

Logs are unloaded at or near the log pond rollways. It is somewhat unusual for a mill of this size to have a log pond. However, it pays good dividends This is a small log pond and it is serviced by double rollways on either side. The effective pond length is only 50 feet with a width of 10 feet. This pond is lined with wood and has a capacity of about 30,000 gallons of water. Draining and cleaning is scheduled every 10 days.

The logs move from this pond to the log deck by means of a jack-ladder or bull-chain. At a point inside the mill and opposite the log deck the front end of the log on the jack-ladder engages a spring-loaded switch arm which disconnects the jack-ladder. This effectively positions the log opposite the log deck and in front of the kickers. The log is then transferred to the log deck by hydraulic kickers controlled by the carriage operator. This control can be exercised from either of two points. The log deck is short and movement toward the saw is accomplished by a transfer chain which carries the log to the log-stop and loader. All of the equipment up to this point, including the log-stop and loader, has been fabricated by the owner.

This gangsaw is serviced on the in feed side with a disjointed carriage. This might be more pertinently described as two separate carriages, since that is what they are. These carriages provide the gang-mill with much of its inherent efficiency as will be described later. The logs are loaded on the in-feed carriages by the log-stop and loader and are presented to the gangsaw.

The logs pass through the saw and as the front end of the log emerges from the rear of the saw it is grasped by a set of pincers on the out-feed carriage. This reduces vibration of the sawed boards. As the rear end of the sawed log clears the saw the log drops free on the out-feed side of the saw. The entire sawed log is then thrown onto a short transfer section by a pair of hydraulic flippers. This transfer leads to the edger table where the edgerman and slab-picker work side by side.

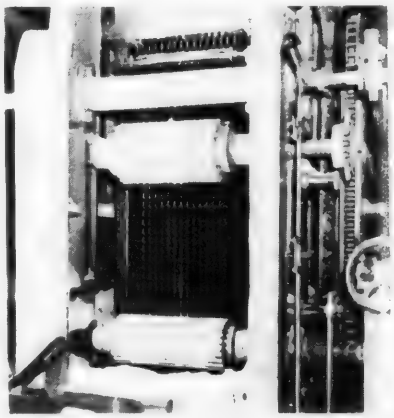

Figure 4.—Close-up view of in-feed side of gangsaw.

[1] Presented at meeting of Forest Products Research Society, Deep South Section, November 8, 1952, Baton Rouge, Louisiana.

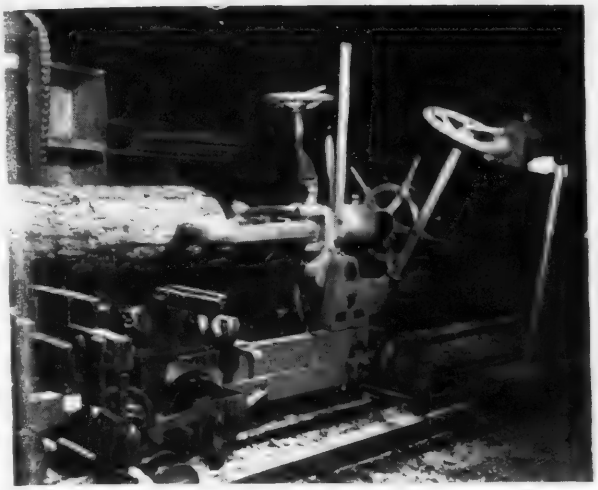

Figure 2.—Two carriages on in-feed side of gangsaw. Note controls on rear carriage to promote efficient sawing of crooked logs. Carriages are now at forward limit and have automatically interlocked. The pincer will release the log and carriages will return to log deck for the next log.

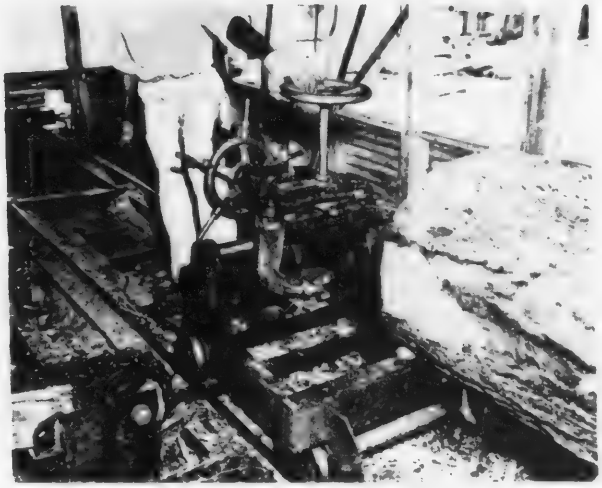

Figure 3.—Rear carriage on out-feed side of gangsaw ready to grasp emerging log.

The boards are edged on a five-saw edger equipped with a shadow-line guide. Live rolls carry the edged boards to the double-end trimmer and from there, by means of another short transfer section the boards move to the automatic accumulating elevator for package stacking.

Sawdust from the headsaw, edger, and trimmer as well as slabs, edging and trim move to the burning pit by means of a deep-well waste conveyor chain.

The Gangsaw

This round log gangsaw is manufactured in Germany by the Esterer Company and has several features not common on similar equipment made in this country. These saws are made in three sizes to fit the needs of local sawing conditions. The size installed by the Livingston Wood Products Company and shown in the accompanying photographs is the smallest of the three.

The frame has a 22″ opening and the sash is equipped with 16 saws. These saws have a 1½″ tooth space and are 51″ long. The sash operates at 320 strokes per minute with a 20″ travel per stroke. The feed rate is variable from 4 to 25 feet per minute and all four of the rolls are powered for feed drive. A particularly desirable feature of this saw is the automatic synchronization of feed rate and saw rake, or tilt. This relieves the operator of needless adjustments. Variable feed rate is a critically important innovation in this type of saw.

The individual saw blades are easily and quickly changed. Normally, saws are changed every 3 to 4 hours of operating time. After a sharp set of saws have been placed in the sash, they are all automatically stressed to the same high tension by a hand-operated hydraulic pump. This feature of the saw eliminates the necessity for saw tensioning or rolling as part of the saw maintenance program.

The saws are spaced at 31/32 inches for the production of dried and dressed 25/32 inches lumber. It should be pointed out that efficiency is picked up on this sawing thickness since the usual practice is to cut a somewhat heavier board in order to produce the standard dried and dressed thickness. This scant headsaw thickness is possible because of the extremely uniform boards produced at this mill.

The saws used are 13-gauge and the tooth is swaged to 7-gauge. This is the equivalent of 11/64 inches full. This relatively narrow kerf also contributes to the efficiency of the mill.

Operation of Saw

Normally, this saw has two carriages on the in-feed side and two more on the out-feed side. However, the forward carriage on the out-feed side was removed by the operator and replaced by a sliding steel plate at track level. This allows the emerging log to extend over the just-sawed log and prevent operation slow-downs.

The carriages on the in-feed side of the saw provide the basis for much of the efficiency of this mill. These carriages are equipped with laterally movable bolsters and this movement is controlled from the operator's position at the rear of the in-feeding log. This allows the operator continuously to adjust the position of a curved log as it feeds through the sash. Essentially, what happens is that the logs are sawed in the same plane as the curve or sweep. This is an important feature since a surprisingly large number of small pine logs have sufficient sweep in them to permit the saw to leave the log on ordinary fixed-carriage rigs.

The front carriage bolster level is slightly below the level of the lower feed roll and after the log engages this feed roll, the log is supported only by the saw rolls and the rear in-feed carraige. The rear in-feed carriage mounts a worm-gear controlled pincer which grasps the log and provides for rigidity during the sawing operation. This carriage also allows for vertical movement of that end of the log. As the sawed log emerges from the out-feed side of the saw it is grasped by a similar pincer on the out-feed carriage. The bolster on this carriage is also capable of continuous lateral adjustment. Thus, the two carriages supplement one another in guiding the log through the saw so as to saw the log parallel to the sides. Logs with considerable amount of

(Continued on page 79)

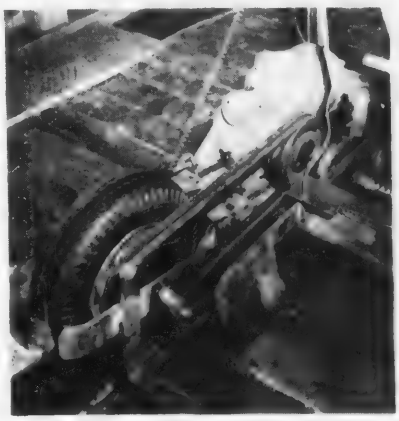

Figure 5.—Rubber-tired wheel operates to move log into saw. Electric motor driving the reducer is serviced by a slide-ring overhead extension line.

Utilization as It Relates to Timber Piling

R. W. WELLWOOD
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Editor's note: This paper was presented as part of a panel on Timber Piling. Although the other panel papers are not available, the editors feel Professor Wellwood's paper and the subsequent discussion on Timber Piling is worthy of publication.

Panel members who took part in the discussion period include: R. W. Wellwood, Chairman; J. B. Alexander, Head, Timber Mechanics Section, Vancouver Laboratory, Forest Products Laboratory, Vancouver, B. C.; P. M. Cook, Manager, Engineering Drillers Ltd., Vancouver, B. C.; J. M. Gurd, Vice-President, Timber Preservers Ltd., New Westminster, B. C.; and G. P. Murray, B. C. Bridge and Dredging Co., Vancouver, B. C.

A TIMBER PILE is a portion of a tree having a straight trunk with limited defects permissible, and within a close tolerance of maximum and minimum butt and top diameters. It must possess strength properties that allow it to sustain static or impact loadings without failure. Normally piling is used for the support of bridges, buildings, wharves, docks and other structures, and in temporary construction.

Species used must combine maximum strength properties with maximum durability or ease of preservation. Suitable species on the West Coast are restricted to three: Douglas fir, western red cedar and western hemlock. Of these Douglas fir is by far the most important.

Statistical Data

Data covering the amount of piling available in timber stands of the Northwest are fragmentary, one reason being that piling is restricted in its size range. Trees can grow into and out of the piling classification in a relatively short period of time. In any event supplies seem adequate for any normal future demand.

The annual production of piling is difficult to obtain with accuracy since poles and piling are frequently recorded together. In British Columbia the 1951 production of poles and piling was 22 million lineal feet, the fourth item in importance in timber production in the province. When classed as a minor forest product they account for 64 percent of the value of products in this class. The writer would estimate that only 10 percent of this total production was in the form of piling. Approximately 80 percent of the output was shipped from the province by rail and by water. Of this quantity, 20 percent went to the United States, 65 percent to eastern Canada and 15 percent to foreign countries. The current demand apparently is very good.

How Piling is Obtained

On the West Coast, piling is obtained to some extent from prelogging operations of the larger logging companies, often handled by a pole and piling company on a contract basis. A relatively large footage of cedar poles originates in this manner, but very few fir piles. For the most part operators are reluctant to contract out the cutting of fir.

Most piling originates in one of two ways:

(a) during standard logging operations in large timber, and
(b) by the cutting of piling timber from second-growth stands.

Whether a logger produces sawtimber only, or develops piling in addition, depends upon the price of No. 3 logs, as well as upon his equipment and facilities. When No. 3 logs are above $50 per Mbm relatively few piles will be available from this source. When log prices drop below this level, small operators find the production of piling attractive. Because of the long length involved, methods must be adjusted to produce this type of log; maximum curvature of road systems can be a limiting factor.

The use of second-growth stands for the production of piling is of more importance to piling producers. The production of piling from stands managed by foresters offers considerable promise, as shown in the southern pine region. Because of species and size limitations, relatively few piles are likely to be produced per acre. By cutting at the optimum time a financial return can be realized without disturbing the sawtimber potential of the stand. Several cuts are possible over a period of time. Although this may not necessarily be the best silvicultural practice, and severe damage could result to the stand, it should be possible to get a substantial return for a partial cut of piling and a final cut of sawtimber. Pulp wood, small sawlogs, and other products will result during these intermediate cuttings.

A comparison of the value of a stand for piling and for sawtimber can be made at the time of inventory preparation, by classifying stems as to sawlog or piling potential. Based on current rates of stumpage for each product, a pile would appear to be worth at least twice as much as a sawlog of the same dimensions. Many trees that are oversize at the butt end for piling, when properly trimmed, will produce a pile, as well as a short sawlog that will help to defray road building and other fixed costs.

Future of the Piling Industry

Some piling will always originate from the standard sawlog operations, and a considerable quantity from "gypo" operators who cut poles and piling on a seasonal basis from small stands. The bulk of the cut will come from more extensive second-growth stands, produce by pole and piling operators, many of whom are connected financially with timber preservation companies. This is a specialized industry requiring equipment and handling methods other than standard ones, and therefore not an industry likely to be dominated by companies interested mainly in producing large volumes of sawtimber or of pulp timber. It is hoped that such stands are to be managed on a sound forestry basis.

Discussion

Q. (Lewis, U. S. For. Prod. Lab.) It was mentioned that three West Coast species were being used for piling. Is any western larch being used on the Coast or do transportation charges preclude its use?

A. There is none used. There is very little larch in British Columbia.

(Continued on page 83)

[1] Presented at meeting of the Forest Products Research Society, Pacific Northwest Section, October 8, 1952, at Vancouver, B. C.

Construction of a Small Low-Cost Vacuum Treating Plant[1 2 3]

F. H. KAUFERT, J. R. NEETZEL, R. L. HOSSFELD, and L. W. REES
School of Forestry, University of Minnesota and Lake States Forest Experiment Station

Plant described, which can be built for approximately $6,000, can usually be fabricated locally. It can handle fence posts and construction lumber and offers opportunity to expand treatment of such products on a local basis where existing commercial plants are not conveniently located.

THE MAJORITY of our wood preservatives are applied to wood in commercial treating plants involving large investments. Most of these are pressure-treating plants. They are equipped to apply preservatives under combinations of vacuum, pressure and heat that are generally recognized as necessary for the best possible preservative treatment. Plants using the hot-cold process are likewise common and are widely used, particularly in the treatment of poles. In contrast to such large-investment plants, which are generally regarded as being able to provide the best possible preservative treatment, are the open dip tanks used by sash and door plants and small wood users and producers for applying preservatives. Soaking wood products in preservatives in such tanks is recognized as providing less protection than more thorough treatment, but the increased service life provided can be considerable and may mean the difference between satisfactory and unsatisfactory service. Brush or spray treatment of wood products with wood preservatives is usually less effective but is good practice for some products when better treatment is not possible.

There is need for a small low-cost treating plant that will provide more effective treatment that can be obtained by soaking or brush application. Such a plant would help expand the field of preservative treatment. The development of a low-cost treating plant of this type has been the object of School of Forestry research for several years. The construction of this plant was stimulated by the need for preservative treatment of the fence posts from thinnings and for some of the lumber produced at our Cloquet Experimental Forest.

The essential considerations for a treating plant of this type were: (1) low construction cost; (2) minimum operating equipment; (3) simplicity of operation; (4) reduced fire hazard; (5) local construction of non-operating parts; and (6) effective treatment of a range of species and variety of wood products.

Background Information

The high cost of pressure treating plants, even of the small treating cylinders and auxiliary equipment now available for small-plant installations, eliminated from consideration this type of plant, which is generally recognized as capable of giving effective treatment to a variety of wood products. The necessity of some type of boiler installation to provide the necessary heat for its operation, resulted in elimination of the hot-cold bath process. Where a suitable source of heat is available the hot-cold bath process would be more practical than it appeared to be in a location such as the Cloquet Experimental Forest.

At the time that serious consideration was being given to the construction of a treating plant at the Cloquet Experimental Forest, there was published an article describing the construction of a small treating plant using the vacuum process (3). This plant appeared to meet most of the requirements listed above and had been used successfully for the treatment of millwork and similar lumber products. At that time little was known relative to the effectiveness of this type of treating process to other wood products, such as fence posts. The author of this publication emphasized the fact that the application of vacuum to remove the air from wood and thus facilitate the penetration of preservatives was not new. The use of a vacuum as the first step in the full-cell pressure treating process and to remove excess preservative at the completion of treatment in all pressure processes is regular practice. The creation of a partial vacuum and removal of air from the wood through the use of heat is also the basis for the effectiveness of hot-cold bath process. In addition, the literature contains numerous references to the creation of partial vacuums or removal of air from wood through heating by steam, vapors of organic liquids, and dry heat (2,4). Treatment by this process is the same in all essentials as that used in the treatment of small wood blocks with preservatives in laboratory tests (4). Descriptions of several recent vacuum treatment installations have been published during the past year (1,5,6).

Construction of the Plant

The basic features of the plant constructed at the Cloquet Experimental Forest are similar to those of the plant described by Garlick (3). The plant consists essentially of the following:

1. A vacuum treating tank
2. An air-cooled electrically driven vacuum pump
3. Supply or storage tanks for the preservative
4. A rough shelter building, mono-rail carrier with a chain hoist, and weighing scales
5. Small surge tank, vacuum gauge, piping and valves.

A general view of the plant is shown in Figure 1. Figure 2 is a schematic presentation of the basic parts of the plant except for the building, mono-rail carrier and hoist.

The Vacuum Treating Tank

The arc-welded vacuum tank is made of 12-guage sheet steel and is 18 feet long, 3 feet 10½ inches wide, and 3 feet 10½ inches deep. Three two-inch pipe connections for filling and emptying are welded into the bottom of the tank. A 1½ inch pipe connection leads from the top of the tank to a 20-gallon overflow tank located between the vacuum tank and vacuum pump. A guage glass which serve as a preservative level indicator

[1] This development is a result of a study undertaken in cooperation with the Lake States Forest Experiment Station, U. S. Forest Service.

[2] Published as Minnesota Agricultural Experiment Station Scientific Journal Series Paper.

[3] Presented at meeting of Forest Products Research Society, Upper Mississippi Valley Section, Wausau, Wis. Dec. 9, 1952.

Figure 1.—General view of the vacuum treating plant constructed at the Cloquet Experimental Forest.

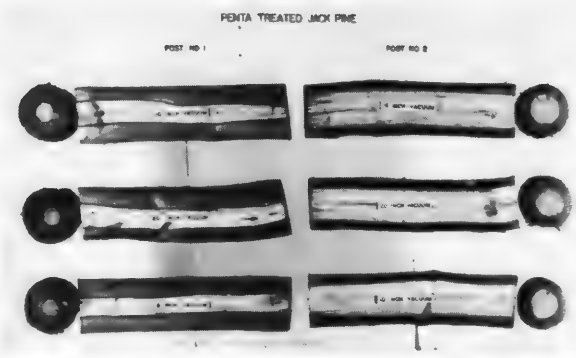

Figure 5.—Cross and longitudinal sections of treated jack pine posts showing penetration with different vacuum combinations.

is located on the end of the treating tank towards the vacuum pump. Channel iron supports are welded to the outer walls for added strength.

The interior of the tank is framed as shown in Figures 3 & 4. The 2-inch plank used on the floor and against the side walls runs the full length of the tank. The end planks are interlocked for added support. Ribs constructed of 2 by 4's bolted in pairs, and set on 6-inch centers provide the interior support needed in a tank of this size. A special feature of the assembly of these ribs is the joining of the horizontal and vertical members in such a manner that equal bracing is obtained on both the side and bottom of the tank. A second feature is that these ribs are held in place by only a single pin in the center bottom plank. These ribs are thus not rigid but have a limited free movement. This flexibility is considered important in obtaining a more effective seal against leakage when a vacuum is drawn on the tank.

The cover for the tank is constructed as shown in Figure 4. The flange for the cover is made from a boiler plate shaped as indicated and with a slight bevel at the bottom to facilitate ready closing. The framing members are notched 2 by 8 inch stock that fit into the formed boiler plate flange. A layer of 2-inch planking the full length of the cover is placed on these framing members and the 12-guage steel cover welded to the flange. Steel reinforcing members previously welded to the 12 gauge cover are tied to the inner framing members at four points with bolts and wide bearing plates. These bolts are welded to the reinforcing members and provide fastenings for lifting the cover.

The tank is completed by cementing a 2 x 1½" sponge rubber gasket to the contacting surface of the cover.

The Vacuum Pump

A rotary vane type air-cooled vacuum pump with a free air displacement of 30 cubic feet per minute and capable of producing a 28½ inch intermittent or 20 inch minimum continuous vacuum is connected to the vacuum tank as shown in Figure 2.

Experience with this type and size vacuum pump has been very satisfactory.

Supply and Storage Tanks

Two tanks, one of 1000 gallon and the second of 500 gallon capacity, are connected with each other and with the vacuum treating tank through pipe connections as shown in Figure 2. The supply pipes reach to within 4 inches of the bottom of the storage tanks. The tanks are buried so that their bases are beneath the frost level and their tops are 3 feet below the bottom of the vacuum treating tank. Since the bottoms of the tanks are below the level to which soil normally freezes in this location, the temperature of the preservative is prevented from dropping to the point where difficulty with sludging of preservative might be expected.

Winter Storage

Since this plant is planned for operation only during late spring, summer, and early fall, storage of preservative solution during the winter months might be a problem. With the preservative used, 5.0 per cent pentachlorophenol in No. 2 fuel oil, crystallization of the preservative and sludging is a distinct possibility at low temperatures. Measurements made at intervals during the winter of 1951–52 indicated that this method of making use of soil heat prevented the temperature of the stored treating solution from dropping below 34°F. at any time. Under these conditions no crystallization or sludging of the preservative has been observed.

Operating experience with the plant through one season has shown that a single 2000 gallon storage tank

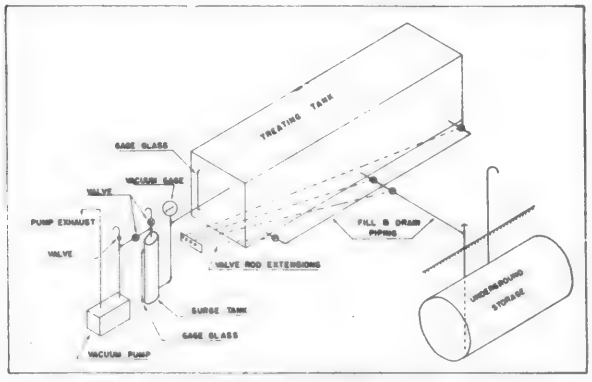

Figure 2.—Schematic drawing showing relative position of different units and piping plan.

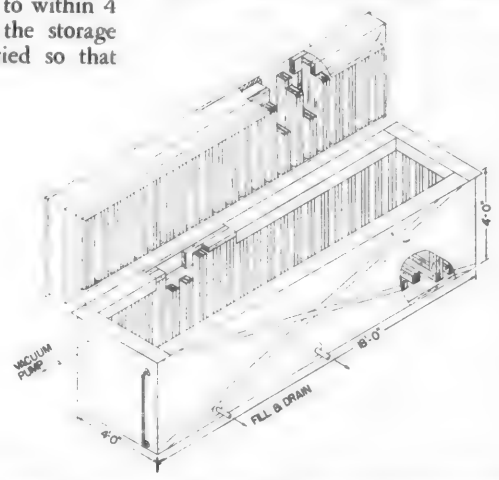

Figure 4.—Construction details of treating tank and cover.

Figure 3.—Inside view of vacuum tank shows method of framing for interior support.

would probably be superior to the present installation.

Auxiliary Equipment

The vacuum pump is housed in a weather tight and well constructed building which also serves as the operating room. The vacuum tank shelter is merely roofed and the upper side walls sheathed to provide some protection from driving rains during operation. The framing members of this shelter are sufficiently strong to support the mono-rail carrier with its load.

The piping, valves, and gauges necessary for a plant of this type are shown in Figure 2. All valves connecting the treating chamber with the supply tanks can be operated from the shelter housing the vacuum pump. This permits one man to operate the plant without difficulty.

Operation

Operation of the plant is very simple. The cover is removed by means of the chain hoist and placed on the top of the room housing the vacuum pump. It is important that this structure be built sufficiently strong to support this weight. The treating chamber is then loaded by means of slings and the chain hoist or by hand. A large beam scale can be inserted between the hoist and load to measure retentions accurately. The scales in this plant have a capacity of 2500 pounds.

After the chamber is loaded, cross chains are connected to keep the wood from floating, the cover is replaced, the valves to the storage tank are closed, and the vacuum pump is started. When the desired vacuum has been reached it may be maintained for the desired period by adjusting the bleeder valve. The valves to the storage tanks are then opened and the preservative is drawn by the vacuum into the treating tank until the material to be treated is covered as indicated by the glass gauge at the operating end of the treating tank. The operating vacuum is maintained at a constant valve during the filling process and may be maintained for any desired period after filling. The preservative is removed by breaking the vacuum and permitting it to return to the storage tanks by gravity. After draining the tank a final vacuum may be applied to remove some of the excess preservative and help dry the surface of the treated wood. Experience to date has shown that with readily treated and dry material of such species as red (Norway) or jack pine, penetration of the sapwood is very rapid and the vacuum following filling needed to be maintained for only a few minutes.

Table 1—ABSORPTION OF PRESERVATIVE OBTAINED WITH JACK PINE FENCE POSTS USING VARIOUS VACUUM COMBINATIONS

	Absorption of Preservative[1] Pounds per cubic foot			
	Entire Post		Sapwood	
	Total	Net	Total	Net
10-inch vacuum[2]+20-inch revac.	7.35	4.77	10.00	6.49
15-inch vacuum[2]+20-inch revac.	9.13	5.95	12.50	8.14
20-inch vacuum[2]+25-inch revac.	12.72	8.17	17.25	11.08

[1]5% solution of pentachlorophenol in No. 2 fuel oil.
[2]Each value is an average of 20 sections.

ESTIMATED TIME SCHEDULE FOR THE TREATMENT OF DRY JACK AND RED PINE FENCE POSTS

1. Time required to load treating tank and set cover	10 min.
2. Time required to reach a 15-inch vacuum	5 min.
3. Vacuum held at 15-inches for	0 min.
4. Time required to fill tank under 15-inch vacuum	5 min.
5. Vacuum held at 15 inches after filling for	0 min.
6. Time required to release vacuum and empty tank	6 min.
7. Time for drawing and releasing final 20-inch vacuum to remove excess preservative	8 min.
8. Time required for removing cover and unloading	10 min.
Total cycle	44 min.

It is recognized that for material not so readily treated the treating cycle must be considerably lengthened if satisfactory treatment is to be obtained. This applies particularly to number 3 and 5 in the time schedule.

Treatment Obtainable

Both encouraging and discouraging results have been obtained with this treating process in the two seasons the plant has been operated. This experience has shown that wood must be dry, probably not over 20 percent moisture content, for best results. Poorer results have been obtained when treating fence posts immediately after the surfaces have been wetted by heavy rains than when the material is surface dry.

The most encouraging results have been obtained in the treatment of jack and red pine fence posts and lumber of high sapwood content. With such material full sapwood penetration can be obtained with total treating cycles of less than 1 hour. Penetration of sapwood of such material is uniform. Without incising, heartwood penetration is slight, which is equally true when the heartwood of these species is treated by the pressure and hot-cold bath processes without incising.

Absorptions and retentions can be controlled to a considerable extent by adjustments in the amount and length of vacuum applied. Some estimate of the absorptions obtained with various vacuum period combinations when treating jack pine fence posts is indicated in Table 1. In Figure 5 are shown cross and longitudinal sections of jack pine fence posts which further indicate the excellent treatment obtainable with the vacuum process on this species.

Advantages and Limitations

The advantages of a treating plant of this type are: simplicity of construction and operation, low cost, possible local fabrication of the treating plant, relatively low fire hazard, and quality of treatment obtainable as compared to soak and dip treatments.

The most obvious limitations are: the relatively small size of units that can be constructed, quality of treatment that may be obtained with hard-to-treat woods, and the necessity of having material to be treated surface dry and below 25 percent moisture content.

Summary

A small low-cost wood preserving plant has been built and successfully operated at the Cloquet Experimental Forest of the School of Forestry. The plant is simple and readily constructed. An air-cooled rotary vacuum pump does the double job of removing air from the wood and drawing the preservative from storage tanks into the treating tank. The treating tank is a thin steel shell with wood framing members on the inside and a cover having a sponge rubber gasket that seals the tank when a charge is being treated. The only operating equipment is the vacuum pump.

(Continued on page 79)

Creosoted Plywood[1]

F. L. SAVAGE

Canada Creosoting Company, Limited, North Vancouver, B. C.

Various recent uses of creosoted plywood with through and through penetration suggest this "new" product will meet some tough service requirements satisfactorally.

SUCCESSFUL PRESERVATIVE TREATMENT of Coast Douglas Fir plywood has created a new industrial wood product. Development of this product has been made possible only within recent years, by the introduction of the so called "waterproof glue" plywoods. This type of plywood is manufactured primarily for use under exposed conditions and this feature has been achieved by the use of the phenolic resin glues. Experimental treatments carried out on the earlier types of plywood, which were bonded with a soya glue, were not successful because the preservative treatment destroyed the glue bond. It had been reasoned that water-borne preservatives would cause separation of the plies, but these experiments indicated that even a pressure creosote oil treatment was destructive.

After the introduction of phenolic resin-bonded plywood, an experiment was made in 1942 to determine whether this type would withstand treatment. A sample of ¾" plywood was treated with a charge of marine piling. Several holes were bored in the sample sheet, not more than one inch apart, to provide a most exacting test of the glue line. As in the normal treatment of marine piling, pressures up to 145 p.s.i. and temperatures up to 210°F. were used and the plywood was subjected to a rigorous treating cycle of more than 36 hours. The plywood, after this severe treatment showed no separation of the plies, no warping nor bulging. This was encouraging but no further plywood treatments were made locally until 1950. The original intention of this experiment was to introduce creosoted plywood as a possible medium for sheathing LSP crafts during the war. Lack of knowledge of treated plywood and lack of a need for permanence in these landing crafts were factors responsible for the lack of further development in this field.

Other preservatives such as Wolman Salts and Pentachloraphenol have been used in the pressure treatment of plywood. In the Pacific Coast Region there has been a limited amount of fire proofing plywood using such fire retarding chemical compounds as Minalith and Procote. In British Columbia the treatment of plywood in substantial quantities has been limited to pressure creosoting. The installations of this creosoted plywood will be discussed later.

Coast Douglas Fir plywood is an excellent product for preservative treatment as it takes creosote readily, although much care must be exercised to obtain the final retention and the degree of cleanliness required. The creosote penetrates throughout the sheet when treatments in excess of 12 lbs. per cubic foot of wood are given. For lighter treatments, there is nearly the same penetration, but occasional small spots of light wood will be seen when the sheet is cut. The reasons for this "through and through" penetration are:–

(1) the glue line is not impermeable.

(2) the method of peeling the plies off the log stretches and ruptures the wood, thus breaking down the fibres and reducing the wood's natural resistance to the flow of preservative.

The creosote therefore is able under pressure to penetrate all of the plywood.

A shorter treating period is required in treating plywood than in treating lumber. In no treatment of plywood has it been necessary to extend the cycle much over eight hours. Light treatments of 6 lbs. retention require approximately two hours less than a heavy 24 lb. treatment.

In 1944, experiments were started by J. Oscar Blew and W. Z. Olsen, technologists at the Forest Products Laboratory at Madison, Wisconsin, to determine, over a period of 6 years, the durability of birch plywood treated with wood preservatives and fire retarding chemicals. Encouraging results were obtained under different exposure conditions for the hot press phenolic resin-bonded plywood and the conclusions briefly were as follows:–

(1) The initial dry strength of the glue joint was not reduced.

(2) Plywood treated with coal-tar creosote, or oils containing pentachloraphenol or copper naphthenate, showed generally improved durability under the exposure conditions.

Reports available in the 1946 and the 1950 American Wood Preserver's Association Proceedings provide a complete description of this experiment.

Tests conducted by local plywood manufacturing companies on creosoted Douglas Fir plywood showed no decrease in shear strength from treating. Shear tests on glue joints were measured in percentage of wood failure, the amount of wood failure being a direct function of the glue bond strength. For example, untreated plywood has an average wood failure of 90 to 95 per cent with glue failures representing 5 to 10 per cent. The minimum allowance for wood failure is 80 per cent. The tests showed an average of 95 per cent wood failure for the creosoted plywood samples, clearly indicating that pressure creosote treatment has no effect on the glue bond strength. Local treating experience has shown there is no destructive effect on plywood from pressure creosoting.

The following creosote retentions are recommended for various plywood applications under Canadian climatic conditions. It would be necessary to reconsider the lighter treatments in areas outside of Canada where more severe fungus growth and termite attacks might occur.

Six pounds of Creosote per cubic foot of wood. Recommended for plywood not in contact with soil or water:

(1) General Sheathing.
(2) Sub-flooring.
(3) Roofing.

Twelve pounds of Creosote per cubic foot of wood. Recommended for plywood in contact with soil or fresh water:

(1) Pontoons.
(2) Irrigation Work, lining, etc.
(3) Bulkheads.

[1] Presented at meeting of the Forest Products Research Society, Pacific Northwest Section, October 28, 1952, at Vancouver, B. C.

Twenty-four pounds of Creosote per cubic foot of wood. Recommended for plywood in contact with marine water or under severe exposure conditions such as acidic corrosion.

(1) Scow Sheathing.

(2) Pontoons.

(3) Bulkheads.

(4) General Sheathing under extreme exposure.

Plywood treated for marine use should retain not less than 24 pounds of creosote per cubic foot or wood to guarantee protection from marine borers. Retentions of 28 pounds have been obtained, measured by weighing sheets before and after treatment.

The aforementioned retentions may appear high in comparison with those recommended for lumber under similar conditions. It must be remembered that the plywood is treated throughout whereas lumber receives a picture frame treatment—just a treated layer on the outside faces. An eight pound per cubic foot of wood treatment for lumber is based on the total cubic footage not just the actual volume which receives the creosote.

At present there are five creosoted-plywood pontoon float installations and four boat house pontoon floats in British Columbia of which the larger installations have been promoted by government departments. The pontoons now in service have been built in three sizes:–

(1) 2′ deep by 4′ wide by 8′ long.

(2) 2′ deep by 4′ wide by 10′ long.

(3) 16″ deep by 16″ wide by 8′ long.

The outstanding example of a creosoted plywood pontoon[1] float installation is at Westview, B. C. where a total of 93 units are used to support two floats, both approximately 350 feet long. There were 14,136 square feet of plywood used in the fabrication of these pontoons and this quantity was the first full cylinder load of plywood treated in Canada. These floats replaced untreated log floats that had failed under teredo action in 2½ years of use. The pontoons, designed by the D.P.W.C. were 2′ deep, 4′ wide and 10′ long, constructed of ⅝″ Douglas Fir plywood, on a prefabricated treated framework of 3 inch by 3 inch Douglas Fir. Two inch, No. 10 galvanized screws on 4 inch spacing were used to secure the plywood to the frame. An asphalt mastic was used as the caulking compound. Each pontoon had two plywood stiffener bulkheads and the 3 x 3 framing members had half-lap joints fastened with lag screws. The pontoons weighed 700 pounds each when completed and had a carrying capacity of 2500 pounds per foot of draft. They were installed behind a large rip-rap breakwater which sheltered them from heavy westerly winds.

The floats were inspected last month after thirteen months' service and were found to be in excellent condition. All float sections were level except one which had a cant of 2 inches caused by an eccentric load. A heavy mat of sea growth covered the submerged area of the pontoons. At the time of inspection the pontoons were drawing between 7 and 9 inches of water, depending to a certain extent on the number of fish boats riding alongside. During the first year no maintenance was needed and judging by appearance, it is unlikely that any will be required for some time. The sea growth, if it does not drop off annually, will undoubtedly reduce the carrying capacity of the pontoons. However, it is a simple matter to partially flood the pontoon, remove the securing chains and pull the unit out for scraping. To return the clean pontoon, the pontoon is partially filled with water, guided under the float and pumped dry.

The fishermen who are the sole users of the floats are completely satisfied with them. They like the constant height above water, the load carrying ability and the wide, level deck. An interesting incident occurred earlier this year when a fish boat, which had filled with water, was prevented from sinking by the mooring ropes tied to the float.

This pressure creosoted plywood is unique in that, because of the complete penetration, it can be framed after treatment with no injurious effects. In this respect, it is of untold advantage to companies who are concerned with marine borer attack for it eliminates tedious preframing required when sheathing barges or buoyancy units for drydocks, etc. An oil barge in Vancouver Harbour was sheathed recently with creosoted plywood. The original planks were scraped clean and hot tar applied to the surface. This was covered by Irish Ship's Felt, a felt impregnated with coal tar creosote, and ½″—4 x 8 foot sheets of good one side grade creosoted plywood were fastened securely on top of these layers to the original planking. Finally all seams were caulked with an asphalt mastic.

Plywood treated with a 24 pound creosote retention also has been used in a pulpwod chip chute where acidic corrosion had previously destroyed other wood lining. The panels have stood the test well but have not been installed for a sufficient period of time to give a factual service record.

One panel of the same retention was recently used in a fish boat as a very effective watertight, decay proof bulkhead.

Application of this creosoted wood product to industrial use has just begun. The lack of development of creosoted plywood during the war was due to the strict allocation of plywood, the lack of knowledge of this new wood product, and, most important, the lack of a need for permanence. If permanence had been a requisite, the application to many jobs would have been accelerated. After the war there was a heavy demand for plywood and little or no need for extending sales markets. When it became apparent that plywood would have a greater adaptability if steps were taken to increase its service life under exposed conditions, pressure creosoting was promoted locally as the solution to this problem. At present, there is some headway being made and architects, engineers, and contractors are realizing the products' usefulness. Other potential users are still skeptical and are watching the new applications in various fields before trying the product themselves.

With today's emphasis on forest conservatios, creosoted plywood pontoons offer an excellent means of conserving saw logs which have been used for floating installations. The treated plywood panels offer a saving in installation labour costs and an increase in service life as compared with planking. A large area can be covered quickly by workmen using panels and the numbers of seams are greatly reduced. A longer service life can be expected with use of the "through and through" type of treatment to which the plywood lends itself. Treated plywood is not as vulnerable as is lumber for abrasions or saw cuts will only uncover more treated wood.

The fiield for treated plywood panels will expand when construction men, designers, and others appreciate the versatility and advantages of this new creosoted wood product.

Discussion

Q. Were the framing members of the pontoons creosoted?

A. Yes, they were.

(Continued on page 80)

[1] Described, Wood Preserving News, November, 1951.

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(2) 2′ deep by 4′ wide by 10′ long.

(3) 16″ deep by 16″ wide by 8′ long.

The outstanding example of a creosoted plywood pontoon[1] float installation is at Westview, B. C. where a total of 93 units are used to support two floats, both approximately 350 feet long. There were 14,136 square feet of plywood used in the fabrication of these pontoons and this quantity was the first full cylinder load of plywood treated in Canada. These floats replaced untreated log floats that had failed under teredo action in 2½ years of use. The pontoons, designed by the D.P.W.C. were 2′ deep, 4′ wide and 10′ long, constructed of ⅝″ Douglas Fir plywood, on a prefabricated treated framework of 3 inch by 3 inch Douglas Fir. Two inch, No. 10 galvanized screws on 4 inch spacing were used to secure the plywood to the frame. An asphalt mastic was used as the caulking compound. Each pontoon had two plywood stiffener bulkheads and the 3 x 3 framing members had half-lap joints fastened with lag screws. The pontoons weighed 700 pounds each when completed and had a carrying capacity of 2500 pounds per foot of draft. They were installed behind a large rip-rap breakwater which sheltered them from heavy westerly winds.

The floats were inspected last month after thirteen months' service and were found to be in excellent condition. All float sections were level except one which had a cant of 2 inches caused by an eccentric load. A heavy mat of sea growth covered the submerged area of the pontoons. At the time of inspection the pontoons were drawing between 7 and 9 inches of water, depending to a certain extent on the number of fish boats riding alongside. During the first year no maintenance was needed and judging by appearance, it is unlikely that any will be required for some time. The sea growth, if it does not drop off annually, will undoubtedly reduce the carrying capacity of the pontoons. However, it is a simple matter to partially flood the pontoon, remove the securing chains and pull the unit out for scraping. To return the clean pontoon, the pontoon is partially filled with water, guided under the float and pumped dry.

The fishermen who are the sole users of the floats are completely satisfied with them. They like the constant height above water, the load carrying ability and the wide, level deck. An interesting incident occurred earlier this year when a fish boat, which had filled with water, was prevented from sinking by the mooring ropes tied to the float.

This pressure creosoted plywood is unique in that, because of the complete penetration, it can be framed after treatment with no injurious effects. In this respect, it is of untold advantage to companies who are concerned with marine borer attack for it eliminates tedious preframing required when sheathing barges or buoyancy units for drydocks, etc. An oil barge in Vancouver Harbour was sheathed recently with creosoted plywood. The original planks were scraped clean and hot tar applied to the surface. This was covered by Irish Ship's Felt, a felt impregnated with coal tar creosote, and ½″—4 x 8 foot sheets of good one side grade creosoted plywood were fastened securely on top of these layers to the original planking. Finally all seams were caulked with an asphalt mastic.

Plywood treated with a 24 pound creosote retention also has been used in a pulpwod chip chute where acidic corrosion had previously destroyed other wood lining. The panels have stood the test well but have not been installed for a sufficient period of time to give a factual service record.

One panel of the same retention was recently used in a fish boat as a very effective watertight, decay proof bulkhead.

Application of this creosoted wood product to industrial use has just begun. The lack of development of creosoted plywood during the war was due to the strict allocation of plywood, the lack of knowledge of this new wood product, and, most important, the lack of a need for permanence. If permanence had been a requisite, the application to many jobs would have been accelerated. After the war there was a heavy demand for plywood and little or no need for extending sales markets. When it became apparent that plywood would have a greater adaptability if steps were taken to increase its service life under exposed conditions, pressure creosoting was promoted locally as the solution to this problem. At present, there is some headway being made and architects, engineers, and contractors are realizing the products' usefulness. Other potential users are still skeptical and are watching the new applications in various fields before trying the product themselves.

With today's emphasis on forest conservatios, creosoted plywood pontoons offer an excellent means of conserving saw logs which have been used for floating installations. The treated plywood panels offer a saving in installation labour costs and an increase in service life as compared with planking. A large area can be covered quickly by workmen using panels and the numbers of seams are greatly reduced. A longer service life can be expected with use of the "through and through" type of treatment to which the plywood lends itself. Treated plywood is not as vulnerable as is lumber for abrasions or saw cuts will only uncover more treated wood.

The fiield for treated plywood panels will expand when construction men, designers, and others appreciate the versatility and advantages of this new creosoted wood product.

Discussion

Q. Were the framing members of the pontoons creosoted?

A. Yes, they were.

(Continued on page 80)

[1] Described, Wood Preserving News, November, 1951.

Packaging as a Management Tool[1]

LT. COL. ROBERT W. JOHNSON
Air Materiel Command, Wright–Patterson Air Force Base, Ohio

In the light of national and worldwide economic conditions it is unlikely that we again will be able to create and maintain huge outdoor stock piles of war material for combat activity. On the other hand, the lightest possible packaging must be devised for quick movement of materials by air to any front, at the same time foreseeing the requirement for packaging for suitable beachhead operations and for water and surface shipment.

Management is now faced with the selection of a course in the military packaging field that will give a safe middle ground to follow during the transition period from practices prevailing during World War II to those to be expected from the techniques of the Air Age.

I HAVE SELECTED this as a topic for my talk today because I am sure you will agree that packaging in its broadest sense is a matter which deserves a careful and continuing consideration of management and should be employed as a most valuable tool in the attainment of management's objectives. Since I am here to speak for the Air Force, I will limit my discussion of management considerations to those which have to do with military packaging. I will, at the same time, refrain from the discussion of technical considerations such as are commonly discussed when packaging is the theme. Ever since my return to active duty in June of last year I have concentrated my efforts on orienting my associates on the staff at Hq AMC and at Hq USAF as to the necessity for appreciating and dealing with management considerations rather than with the particulars of an item's pack.

Let us determine first what it is about packaging that makes it a matter of vital concern to our managers. Packaging in its limited sense is the application to items of material such processes, methods, materials and techniques as are necessary to preserve items in storage and to protect them from the hazards of handling and shipping. The purpose of packaging is to insure the delivery of material to the ultimate consumer in ready-for-use condition; or, in the case of reparable items, in the same status of a recoverable asset. In this sense, then, packaging is the insuring factor of logistical support and, as such, is a responsibility of management.

As in any well operated business, management is concerned to see that its assets are adequately covered by insurance and by the same token that the premiums paid for the insurance are not excessive and remain in balance with the overall operating requirements of the business. In the case of packaging, the premiums we pay are itemized in terms of manhours, materials, (often critical and expensive and techniques; and are totaled in terms of weight and cubage. That this insurance bill has been excessive and has failed to remain within the limits of operational requirements has been clearly recognized as is evident by the ever increasing emphasis which is being placed on the necessity for treating the subject as a management function.

Establishing Policies

In order to illustrate the application of these broad generalized statements to specifics, let us see what factors we should consider in establishing policies for the guidance of our packaging people. In the evolution of such policies, we must bear in mind that they must be flexible and that they must be completely compatible with constantly changing requirements to accord with current military necessity.

During World War II, our huge outdoor stock piles and beachhead activities required the ultimate in protective packaging. The urge to secure that maximum type protection still activates us today, both in our policies and in our practices. We continue to be haunted by the ghosts of destruction of World War II. That urge must be stilled—that ghost must be laid. We are maintaining today a military organization comparable approximately to one-half that attained at the peak of World War II. With the exception of the Korean campaign, we are maintaining that military establishment under peacetime conditions. In Europe, we have the most stable of shipping, receiving, storage and handling conditions. Here in the United States, those conditions are far better than at the peak of World War II. In light of the development of national and worldwide economic conditions I think that never again will we be able to create and maintain huge outdoor stock piles of war material for combat activity. The uncertainty of the international situation and the current stresses to which our national economy is presently being subjected make the furtherance of such a concept impossible.

Transition Period

If we are to maintain a position of constant combat readiness, prepared to move in any direction on any front, we will have to work on a hand to mouth basis in so far as pipeline length is concerned. This means then that we are faced with the necessity of devising the lightest and most inexpensive types of packaging for aerial delivery of war material direct to using organizations. This does not meant that we can still not foresee the requirement for packaging suitable for beachhead operations for outdoor storage or for shipment by water and surface forms of transport but we can foresee that a larger portion of our supplies will move by air. We find then that we now have under consideration two extremes: at one end, the ultimate for beachhead type operations and, at the other, the minimum for direct aerial delivery. The management problem with which we are now faced is the selection of a course which will give us a safe middle ground to follow during the period of transition from the practices prevailing during World War II and those to be expected from the techniques of the Air Age.

It will assist us in formulating our policies if we will remember that items used in great abundance, such as petroleum, oils and lubricants, clothing, subsistence and ammunition comprise roughly 80% of our total tonnage but represent only 20% of our dollar expenditures. This consideration leads us to the conclusion that we can very well afford to consider the economies and feasibility of aerial

[1] Presented at meeting of Forest Products Research Society, Deep South Section, Baton Rouge, Louisiana, November 7, 1952.

delivery of that remaining 20% portion of our tonnage which represents an investment of 80% of our dollars. If we make a decision on this basis, I personally think it will give us a far less complicated solution to the problem of determining what and when we should package to the minimum standards. In this latter case, we can safely use the lightest box and most inexpensive type for preparation for shipment because we will not make aerial delivery until those supplies are needed and should therefore anticipate no long overseas storage and none of the hazards of rail and ship loading conditions.

Standardization Essential

Another basic factor which must be taken into account is the absolute necessity for simplicity and for standardization. We must remember that the basic purpose of packaging is to insure the ready-for-use condition of our material; that this responsibility is not confined to a relatively few packaging technicians working under ideal conditions and surrounded by ample resources but rather by people working under widely varied conditions and environments and, all too frequently, on a make-do basis. The instructions and the specifications which we use and the materials and methods which we specify must be easy to understand and follow and supported by a reasonably adequate supply of available material. By standardization, I mean uniformity as to the determination of warehousing requirements, of inventory procedures, of material handling methods and techniques, and of calculation of weight and cubage data for logistical purposes. This implies then that we cannot afford the luxury of spending the packaging technicians' efforts in considering the packaging requirements of our material, item by item. A course of thinking parallel to that followed in deciding what should be shipped by air may be employed in considering this factor. Roughly, 75% of our items are, comparatively speaking, fairly regular in shape, reasonably small in size, simple in design, and present no particular packaging problem. Such items, then, must be identified by their physical characteristics and so segregated and cataloged that the packaging for all of those items which fall within certain logistically feasible physical characteristic groups may be determined once and for all. This, as you can well imagine, is a task of no small magnitude requiring a considerable amount of planning and work. I am firmly convinced that the end result, however, will prove sufficient justification. When it is completed, we will then be in position to devote to the remaining 25% of our items the packaging engineering talent and techniques which they merit because of the critical nature of the materials which they embody or by reason of the high expenditure of manhours required in manufacture and assembly.

In general, the non-critical nature of forest products is what indicates so strongly the desirability of maximum utilization in the solution of our packaging problems. I am sure that analysis of the consumption of lumber on a national basis will indicate that a very large percentage is consumed for packaging purposes. A very important part of that percentage is utilized, of course, in military packaging.

One of the major projects monitored by my Packaging Branch is the evaluation of types of material used for exterior shipping containers in our depots. By careful analysis of the size of containers used and the weight shipped, we have been able to compute the average density of Air Force material. This density factor, when utilized in designing and constructing exterior containers, is the all-important factor which determines the cost of the container. For example, formerly one thickness of lumber or plywood was used for all containers. Our box factories were making one cube containers of lumber of the same thickness as was used for boxes of larger cube. In order to meet military standards and requirements, our office has standaridzed two thicknesses of resawn lumber, and have divided the container design requirements into two groups: 0 to 6 cube capacity, for which we'll use 7/16 sides, tops and bottoms with 9/16 ends and cleats; for 6 to 15 cube boxes we will specify 9/16 sides, tops and bottoms and 25/32 ends. 1/4" and 3/8" stock will be utilized in the construction of plywood boxes. Grade II material from the southern part of the United States will be used in the box factory program, and some Grade III from the West Coast will be acceptable.

Material "Unitized"

Material is being procured in unitized form to expedite materials handling in the depots, as well as in storage areas. Semi-fabricated or finished packing materials are purchased from commercial contractors where it is economical to do so. Fifteen different sized box ends for use in fabricating containers are provided, permitting the manufacture of boxes to accommodate a wide variety of commodities. By utilizing boards of varying lengths for sides, a wide range of boxes can be built. This practice alone resulted in a material savings of 22% of the lumber procured last year for use in depot box factories. The Corps of Engineers purchases all material for the military, and is responsible for inspection. Their efficient scheduling and planning, coupled with industry's production insures the right lumber at the right place at the right time.

So much for our immediate program for the utilization of lumber. Whether we can continue along these lines is questionable. The ever increasing use of airlift in the accomplishment of our logistics mission demands continually a reduction in all tare weights. We are continually on the alert, therefore, for materials which will serve the same protective purpose as lumber and yet which are appreciably lighter in weight. This very factor presents a challenge to all who are concerned with the conservation of our forest resources and in the utilization of forest products. Because of its non-critical nature we should continue to look to the forest for a major source of our supply of packaging materials. In order to meet our requirements for minimum tare weights, therefore, it would seem that the logical approach to the attainment of these two objectives would be to concentrate our research in the production of materials derived from the forest rather than in the use of the unprocessed product. For example, a process which will facilitate the use of molded pulp on a limited production run basis might well be a sound approach.

I believe that consideration of one more major factor will put us on a firm basis for formulating those policies which will establish the trend of military packaging. Up to the present time, it has been the packaging technician's objective, by and large, to protect his item against all foreseeable hazards to include not only those of a providential nature but, likewise, those created by the hand of man. Some ot these latter assume almost the status of the former to the extent that man has permitted himself to become the servant of the machine. In other cases, however, we discover that the man-made hazard is directly attributable to carelessness and rough handling. From a management point of view, I concern myself with the possibility of eliminating such of these last hazards as are conceivably subject to control. If it is possible to do this, it means that I can lower somewhat the levels at either of my packaging extremes with a consequent direct benefit to all of us as taxpayers and citizens. This, in itself, poses a prob-

lem of considerable magnitude. It means that we must eradicate from the minds of our Air Force people that long instilled habit of playing free and easy with military property and replace it with a consciousness that it merits the same loving care as is bestowed by the infantryman on his rifle. It means that we must go back into our basic indoctrination courses, into our service schools, into our staff officers courses and emphasize and re-emphasize to our commanders the vital necessity for material preservation.

From these considerations we can chart our course and determine those policies which will serve to guide us through the transition stage.

We cannot consider the introduction of more than one standard unit package into our logistical system now. There is no way known to us by which we can determine whether an item being manufactured and packaged for the Air Force in your plants is to be consumed in the Zone of Interior, shipped overseas for long term storage, or expended in combat activities. Our selection then of means to reduce weight and cubage for airlift or of means to provide maximum protection for a beachhead is limited practically to the shipping container and the packaging methods. Under our present supply system we must therefore depend to the maximum possible extent on industry to accomplish our basic preservation or unit pack and on our own depots for the application of appropriate packing at the time when shipment is to be made to a known destination by a specified means of transport. This, then, is one of our basic policies. In order to achieve the simplicity and standardization which we have determined as essential, the Air Force is presently engaged in its project for categorization of items by physical characteristics in order that an appropriate packaging decision may be made. As a necessary concomitant we are establishing ground rules which will firm up our unit pack quantities. In doing so, we are working with the other services so that we may make this determination on a mutually acceptable basis. When these projects have been completed, we will have a set of packaging instructions which are easy to understand, which provide the maximum degree of latitude in the selection of methods and materials, which are of equal application to our own depots and our manufacturers, and which will be considered seriously by all services for adoption as a Department of Defense standard.

Our last major policy requires little discussion here since I find that it practically enunciated itself in consideration of the factors involved. We have initiated action through the Air Force Packaging and Materials Handling Board to make indoctrination and training in material preservation and all its phases a requirement in all training and indoctrination curricula within the Air Force. We are planning to establish a series of training courses in strategically located field installations for supervisory as well as for production line workers. The purpose of these courses is to supplement the basic training now afforded by Rossford Arsenal. Within my own Packaging Division, we have a nucleus of junior officers who are being trained to qualify as staff officers in this field. We have proposed to Air Force headquarters that courses such as those offered by Wayne University in packaging and materials handling be formally included in the professional university training now available for Air Force officers. It is our purpose to make all levels of Air Force management aware of the importance of our mission and to provide a structure which will assure continuity of planning and implementation not only for this Air Force but for the one of tomorrow.

It has been our policy for some time past to utilize to the optimum the resources of industry in research, in development, and in the practical application thereof to our current problems. When broken down into their component parts, those problems continue to present themselves to our very small group in headquarters by the thousands. We are neither so opinionated nor so conceited as to imagine that we can hope successfully to solve them within the limits of our own available resources. The fact that we have made the progress we have made to date is due in very large part to the assistance so freely and so ably given by industry and by professional groups such as this. We have only scratched the surface. There is a very long road ahead of us which is conspicuous, primarily, because of its detours and uneven surface. The Air Force in general and the Packaging Division of Air Material Command in particular is counting on you for a continuation of your full-hearted cooperation and coordinated effort in helping us find those answers which are essential to our continued success in battle and to our progress along the paths of peace.

GLUE DISCORD

Because of the difference in the chemical makeup of the various types of glues, care must be exercised in plants where several different kinds of glue are used. Contamination of one glue by another in many cases will seriously impair the efficiency of the glue mix or even render it entirely unusable.

For instance, a very small amount of urea resin glue, which is slightly acid will ruin casein glues which are on the alkaline side. The glue mix will actually have a gelatin-like consistency which will defy all efforts to thin it out.

Of course, the logical answer to this problem would be to provide separate mixers and spreaders for each type of glue. This may not be practical because of the space available, or because one of the glues is used very rarely. The only other answer then is a good thorough cleanup of all equipment before changing from one glue to another.

Mixing equipment, containers and spreaders must have every bit of old glue removed before the other type of glue is used. Plenty of warm water, soap and elbow grease will usually suffice. Use stiff bristled brushes on spreaders taking care to remove all of the glue in the grooves of the rolls.

If caustic solutions are used in this clean-up, be sure to rinse the equipment with clear water, and protect your hands with rubber gloves. These precautionary methods are very important and if used will save a lot of trouble and headaches.

If you are not sure your old equipment can handle a new type of glue, ask your Glue Technician for information. You can rely on his recommendations. —National Casein Co. Bulletin.

Package Durability Through Preservative Treatment[1]

G. G. GARLICK

Director of Research, Protection Products Manufacturing Co., Kalamazoo, Michigan

Reported tests show that water repellent preservative of good quality provides protection to wood boxes and their contents. Tests compare treated and untreated boxes for periods up to 18 months.

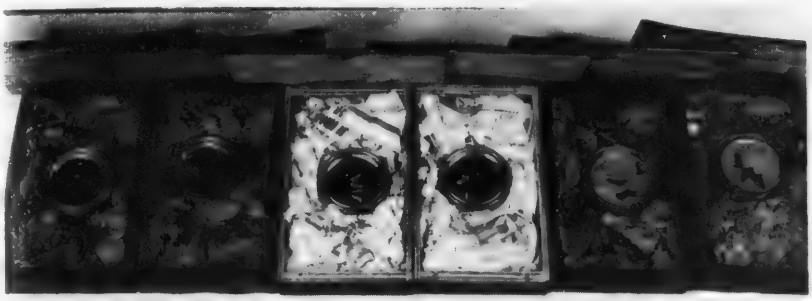

Figure 1.—Six boxes made from interior grade plywood, using soybean glue. Pair of boxes on left were treated with Air Corps Sealer No. AN-S-17 (for wooden glider wings); center pair were treated with a good grade water-repellent preservative; pair on right were left untreated. Photo was taken after 18 months exposure in outdoor test.

IN CONSIDERING WAYS and means of improving the durability of wooden shipping containers so that they will last longer and remain tight and free from stain and decay fungi, as well as do a better job of protecting their contents, we must first consider the research that has taken place to prove the merits of the modern water-repellent preservative type of treatment for wood. This type of treatment does not change the appearance of the wood, and when dry, leaves the wood clean, paintable and odorless. First placed on the market back in the early 30's, this type of product has been widely used throughout the millwork and lumber industry, and to day is covered by Military Specification MIL-P-906b and also Federal Specification TT-W-572.

Wood has strength and can take a lot of wear and abuse and still hold its shape; it has good resistance to impact, thereby protecting the contents. Because of is resilient nature and soft surface, it adds extra protection to the contents of the container. It can be easily and quickly repaired in case of damage to one part of the package.

One weakness of wood is that it absorbs water, causing swelling and shrinking, which over a period of time causes a box to pull apart at the joints as well as to check and split. Unless the metal fastenings are heavily coated, dampness in the wood will cause them to rust and in time fail. Also, if the moisture in the wood reaches the fiber saturation point or above, decay and stain set in.

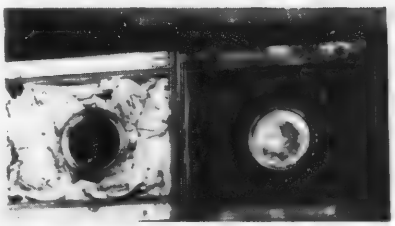

Figure 2.—Two small test boxes which were exposed to the weather for 15 months. Box on left had received a 30-second dip in water-repellent dip; box on right was not treated.

Wood may also be attacked by such insects as termites, lyctus beetles, carpenter ants and other wood-destroying insects.

Wood has a natural affinity for water, and some species pick it up almost as readily as a blotter. A good water-repellent preservative will penetrate into the surface cells of the wood and break up this natural affinity for water, and actually turn it away.

An untreated box set out in the weather absorbs rain or moisture readily. Long exposure causes the water to soak clear through the wood. Water will wick around boards and work into the box through the butted edge joints as well as at the corners. Be-

[1] Presented at Meeting of Forest Products Research Society, Great Lakes Section, October 31, 1952, Ann Arbor, Mich.

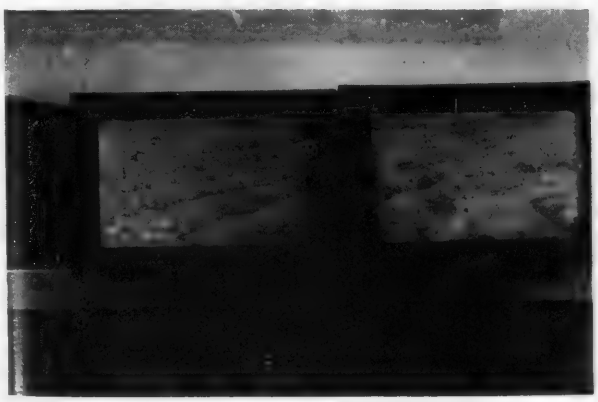

Figure 3.—Two boxes made from one-inch lumber. Photographed after exposure in heavy rain. Treated box is on left.

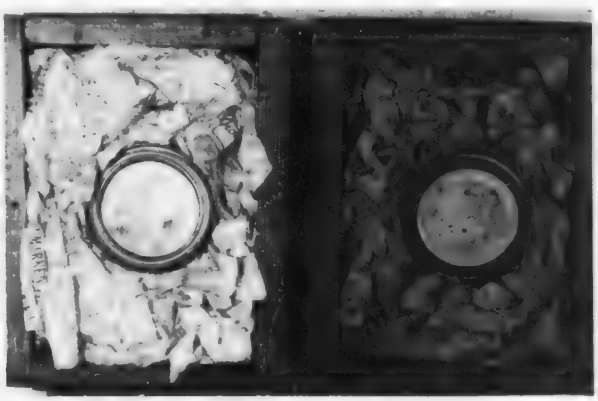

Figure 4.—Same boxes as shown in Figure 3. Treated box on left.

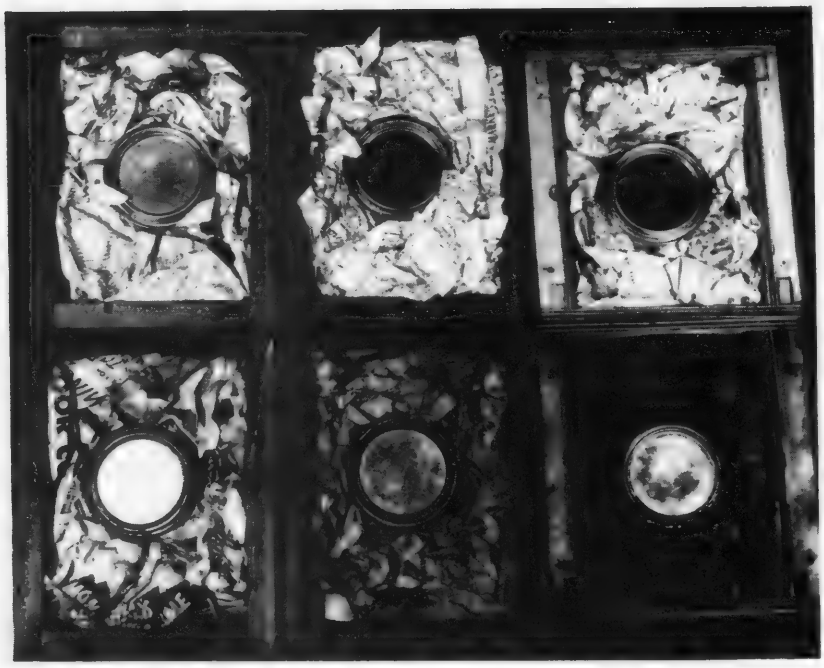

Figure 5.—Three sets of exposure boxes opened after (left to right) 30, 60, and 90 days respectively. Boxes in top row were treated; those in lower row were untreated.

Figure 6.—Top half of this plywood box was treated with water-repellent preservative; lower half of box was left untreated. Photo taken after 5 months exposure.

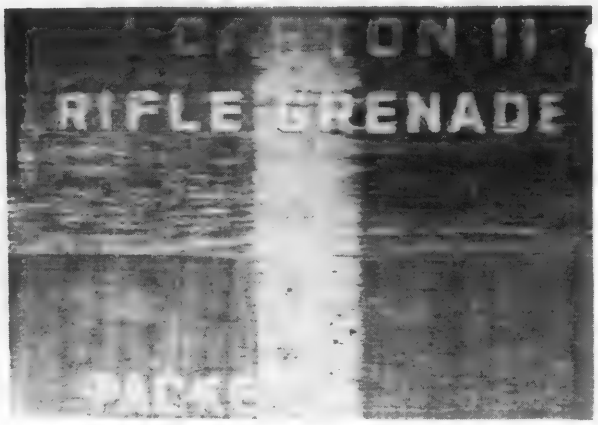

Figure 7.—Left side of box was treated with water-type camouflage stain; right side of box was treated with water-repellent preservative type stain. Note how white lettering has been darkened by water-type stain.

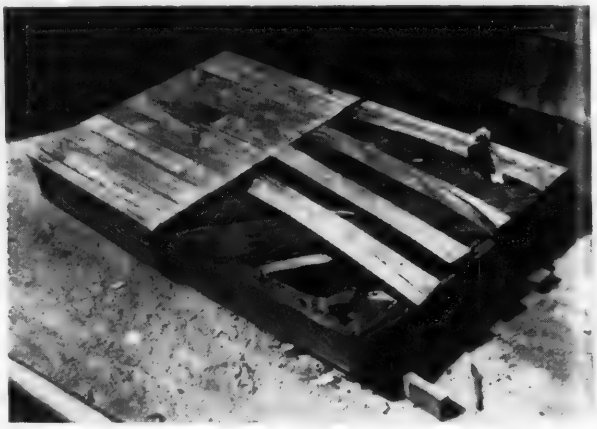

Figure 8.—Two box-like structures after 7½ years exposure. Before test, structure on left was given three minute dip in water-repellent preservative.

cause of the capillary action created when two pieces of wood are placed in contact with each other, this wicking action seems to act more rapidly in boxes which are tightly fitted together.

A water-repellent preservative plays a very important part in protecting a box as well as its contents, because, even though the box is exposed long enough for the exposed surface to become wetted due to the beating of the rain, there is no tendency for the water to wick in between the boards or the joints. Hence, where boxes are tightly fitted together and especially where tongue and groove construction is used, the contents can be given a high degree of protection against water working in.

Research was carried out on boxes constructed of Douglas Fir plywood. Some of the boxes were left untreated, while others were dipped in Wing Sealer, and still others were dipped in a good water-repellent preservative, and then a bright tin can was placed in the center of each test box, and common newspaper used as packing around it, so that if moisture got through the box it would wet the paper, causing the paper to mould and mildew and carry moisture to the can, causing it to rust. The covers of these boxes were screwed on with one screw in each corner, and no attempt was made to seal the cracks around the cover and bottom.

(Continued on page 80)

Figure 9.—Test block 2 by 2 by 4½ in. was treated one end only by water-repellent preservative with three minute dip. Untreated end (shown) after 6 months in laboratory termite nest was eaten through and showed checking and decay.

Improving the Performance of Ventilated Dry Kilns

RAYMOND C. RIETZ

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Refinements in the use of split schedules are essential if power and steam costs are to be held to a minimum. The operator should be on his toes to take advantage of opportunities to manipulate the schedule to get faster drying without increasing seasoning losses. There are 48 different combinations of humidity schedules which can be combined with 13 different temperature schedules in finding the most economical drying procedure for any given set of conditions.

THE VENTILATED dry kiln being used today to dry plank, lumber, dimension stock, bowling-pin blanks, shoe-last blocks, and the numerous other rough wood items cut from logs is not a new piece of mill and factory equipment. Since the early 1920's, however, many of us have seen remarkable improvements made in its design and operation. These improvements, I feel, have had a significant bearing on the present-day acceptance of kiln drying as a practical process. In reality, it has been but a comparatively short time since many woodworkers refused to use rough wood unless it had been air dried for a long period of time. The wood had to be seasoned or "cured" before it was fabricated, and this usually meant slow, and as some called it, "natural" drying in the atmospheric elements of the out-of-doors. Many believed that wood required long periods of air drying before it was suitable for most fabrication purposes. To speed up the drying process in any way was considered an artificial procedure, and many woodworkers assumed that no good could come from such unorthodox doings. In all too many cases, these conclusions that kiln drying adversely influenced the working properties of wood were justified. Footage losses due to seasoning degrade were often appreciable, and case-hardening was a mysterious condition causing considerable trouble in machining.

Need for Fast Drying

The need to reduce the time interval between the standing tree and the finished wood product encouraged research in the drying of wood and the development of dry kilns which would do a better job. The accomplishments are obvious to all of us, for the modern dry kiln and its efficient operation now enable us to dry almost any wood item green from the saw quickly, economically, and with a minimum of seasoning degrade. Only the more refractory hardwoods, such as some of our southern oaks and certain softwoods similar to the sinker stock of redwood, require air drying prior to kiln drying to make the over-all seasoning process economical. I say that kiln drying is not an artificial process; it is a controlled process.

Some day the interesting history of the development of kiln drying and the ventilated dry kiln will be written. Many complicated processes have been developed and discarded as being impractical. New methods and equipment will continue to be investigated, and we should not be satisfied with our present equipment and drying results. The ventilated lumber dry kiln has outlasted all of the others that have been invented and promoted in the last three or four decades. Because of the simplicity of its design and construction and relative cheapness of its operation and maintenance, it has withstood the competition of all other drying systems.

Ventilated Dry Kiln

A ventilated dry kiln is one that relies on vents to carry away the moisture that has been evaporated from the wood. The moisture-laden air that is exhausted is replaced by fresh air which must be heated to the dry-bulb temperature at which the kiln is being operated; thus, heat is lost at the vents and heat is required to heat the incoming fresh air up to the dry-bulb temperature. The loss of heat through ventilation and the need to heat the incoming fresh air has always been a thorn in the side of the kiln designer, but it is usually cheaper to waste heat through ventilation than to remove the evaporated moisture in some other manner.

With this definition or description of the basic element of the ventilated kiln, it is of interest to review briefly the significant improvements that have been made in its design. Many of you are familiar with the lumber driers often called "hot boxes." These were ventilated dry kilns usually of the natural-draft type. Sometimes the amount of ventilation was not adequate, and often the vent location was not proper to take maximum advantage of stack effects. The kiln was heated in a number of different ways and drying results were variable. The drying of green or partially air-dried woods in these driers often caused considerable loss due to checking, end splitting, and honeycombing. When well-air-dried hardwoods were placed in these kilns, however, drying was usually quite satisfactory and sometimes the drying time was phenomenally short. The kiln was not adapted to what we would now call a controlled drying process.

Controls Simplify Operation

Perhaps the most significant developments in the modification of the natural-draft ventilated kiln occurred during World War I. At least a tremendous stimulus was given to the development of a kiln design in which relative humidity could be controlled. Refractory woods had to be kiln dried green from the saw, and the importance of relative humidity control to prevent surface and end checking became evident. The water-spray kiln, which was not a ventilated kiln, was developed to provide the needed control of relative humidity, and remarkable drying results were accomplished in commercial installations of this kiln type. The value of relative humidity control as a means of keeping footage losses due to surface checking and end checking to a minimum certainly was demonstrated. In addition, the increased circulation through the pile of lumber produced by the water-spray design reduced drying time.

Soon after the water-spray lumber dry kiln was invented, the dry- and wet-bulb recorder-controller was made available by instrument companies. With this greatly simplified

[1] Presented under the title New Short Kiln-Drying Schedules at meeting of the Forest Products Research Society, Midwest Section, Clinton, Iowa, October 10, 1952.

[2] Maintained at Madison 5, Wis., in cooperation with the University of Wisconsin.

approach to relative humidity control where steam was available for humidification, the improvement in ventilated kiln designs spurted. Of major importance was the invention of the internal-fan kiln design. This kiln demonstrated the advantages of forced-air circulation in the drying of wood, and shortly after its invention many modifications of internal-fan arrangements, design of baffling systems, and external-blower kilns came into being. Competition in dry-kiln design was keen. Patents were fought in the courts. Out of it came the forced-air-circulation ventilated kiln, with automatic control of the dry- and wet-bulb temperatures and the automatic opening and closing of the vents and fresh-air intakes, as we know it today.

The original invention of the forced-air-circulation dry kiln and the subsequent improvements by the dry-kiln companies and engineers have given us a dry kiln in which wood drying can now be considered a technical and a controlled process.

Reducing Costs Is Challenge

The wood producer and the woodworker are continually faced with the problem of reducing drying costs. Therefore, they will always be interested in wood-drying processes which have good possibilities of being not only faster but also cheaper. When new processes or kiln designs are developed which claim to greatly reduce kiln time, the factory owner is immediately interested, because reduced kiln time usually means greater output per kiln unit and a possible reduction in over-all drying costs. The inventor, however, is faced with the problem that reduced kiln time is of little interest to the lumberman or factory owner unless drying costs are reduced enough to warrant replacing present equipment. I believe that the Western Pine Association has demonstrated that the solvent-drying process reduces the drying time of ponderosa pine appreciaIy, but the process has not been adopted commercially because drying costs are not expected to be less than those of present drying methods using ventilated kilns. Kiln drying lumber in forced-air-circulation ventilated kilns where fuel costs are relatively cheap is going to be a hard economic set-up to beat by any other drying processes, whether it is high-frequency heating, solvent or vapor drying, or other methods of supplying the heat needed for the moisture-evaporating process. Yet it must be remembered that the ventilated kiln is waseful of heat and heat economy means dollars saved. The challenge is interesting, for, from an engineering standpoint, various possibilities of heat conservation are apparent; but regardless of how the kiln companies and engineers go about solving this problem, those of you who have ventilated kilns are more interested in ways and means of improving their performance.

The designers of ventilated kilns in Scandinavian countries favor the use of external blowers and the use of heat exchangers on the tops of the kilns by which the incoming fresh air is heated by the out-going vented air. The only kiln designer in the United States that I know about that is doing something along this line is Mr. Guthrie. His kiln design is an indirect, oil-fired, furnace-type kiln, and the incoming fresh air is brought into the system in a duct surrounding the stack from the oil burner. He does not use the vented air to heat the incoming fresh air. Depending upon where the vents and fresh-air intakes are located, the kiln designers can and probably will consider the use of heat exchangers as a means of utilizing the heat in vented air. Other sources of heat losses will also bear investigation. These are the radiation losses which can be reduced by more and better insulation, and infiltration losses which can be stopped by tightening up the structure, including the doors. An interesting way to use the hot, moist air being vented was suggested recently. Why not use it to heat and humidify the factory during the winter months?

Higher Circulation Rates

Regardless of how the moisture evaporated from the wood is removed from the drying chamber, I feel that the benefits of forced-air circulation are well known and established. As kiln time becomes more and more valuable, higher circulation rates can be afforded, and I predict that we will see dry-kiln designs having much higher circulation rates than our present kiln installations.

Of more immediate importance to us is the consideration of ways and means of improving the performance of the ventilated kilns that are now in operation. The objective is to increase the output of the kilns without increasing seasoning losses, and to reduce the energy input per 1,000 board feet of kiln-dried lumber. We have been so accustomed to having ample fuel that steam requirements of the dry kiln have not been of great concern. However, if any of you are buying coal to augment your fuel supplies, any practical thing you can do to keep steam consumption down will keep coal costs down.

Ways to Save Heat

Perhaps the first thing to do is to tighten up the kiln structure to reduce both heat and vapor losses. It can be argued that as long as we are operating a ventilated kiln it doesn't make a great deal of difference whether the moist air is being discharged through the vents or through cracks in the walls and ceilings or opening around the door. Heat conservation, however, requires controlled venting, and the drying schedule should be modified to keep the vents closed as much as possible. The kilns are the big steam users at most plants, so obviously the vents are the places to start conserving steam. Covering pipes adequately, repairing leaky valves, and checking traps for proper functioning are all part of a program to reduce steam consumption. It may seem trite to say that the vents also need to be fitted tightly, but for kiln drying hardwoods particularly, it is important that the vent caps fit snugly to get a good seal. Remember that the vents are on the pressure side of the fan and any openings that result in unnecessary air losses increase the need for steam, for the incoming cold air must be heated to the dry-bulb temperature. These same air losses through leaky vents carry away vapor that must be replaced by steam to maintain the desired wet-bulb temperature.

The ultimate in automatic vent control, as I see it, is for the steam spray never to come on except when equalizing and conditioning. If during active drying the wet-bulb temperature is maintained by steam injection, along with an opening and closing of the vents, steam is actually being wasted. It is being put into the system at one place and allowed to escape at another. Seal up the kiln to reduce exfiltration and infiltration heat and vapor losses and really put vent control into high-class controlled operation.

Inadequate Ventilation

If you are kiln drying green softwoods or the sapwood of any of the hardwoods, your problem may well be inadequate ventilation, particularly in the early stages of drying.

You may have trouble keeping the wet-bulb temperature down to the desired setting. Some of the recent kiln installations in the West, for the kiln drying of ponderosa pine, are provided with auxiliary hand manipulated vents, so that when the sap grades are being kiln dried, literally about half of the kiln roof can be opened up. It would be folly to keep these auxiliary vents open when the controller begins to call for steam to maintain the wet-bulb temperature setting. Because of the great amounts of air vented to carry away the evaporated water, considerable steam is needed to heat the incoming fresh air, but that is a requirement of fast drying when the item can be pushed.

The secret of lowered steam consumption per 1,000 board feet kiln dried to desired moisture levels is to keep the kiln time to a minimum, for the shorter the kiln time the less will be the radiation losses assessed against each pound of water evaporated. Reducing kiln time by days, half days, and hours is where the craftsmanship of the kiln operator comes into the picture. The drying schedule with its changing pattern of dry-bulb and wet-bulb temperatures determines kiln time, steam and energy consumption, and seasoning losses.

How do we go about modifying our kiln schedules to obtain fast drying without increasing seasoning losses, and yet reduce our steam and energy consumption? We have two accelerators to work with as part of a drying schedule. These accelerators are the dry-bulb temperature and the relative humidity. In discussing the dry-bulb accelerator, we are interested in knowing when we can push it to the floor board and where the floor board is located in, say, respect to the boiling point of water. The critical temperature theory comes into play, for it tells us something about how high an initial dry-bulb temperature can be safely used. Some woods have critical temperatures above the boiling point of water; thus they can be kiln dried in superheated steam, taking advantage of the higher diffusion rates that result from the use of such high temperatures. The sapwood of most woods is quite pervious, and the drying rate is pretty much a function of the rate at which the heat can be provided, the moisture carried away, the temperature of the wood, and the steepness of the moisture gradient. Discolorations like brown stain in northern white pine sometimes govern the dry-bulb temperature that can be used. With such exceptions in mind, the critical temperature approach tells us something about the initial dry-bulb temperature that can be used on green stock.

When Dry-Bulb Temperature Can Be Raised

Experience and our research studies indicate that when the free water has been evaporatd, the dry-bulb temperature can be elevated to rather high levels without honeycomb developing. Now what does this all mean insofar as the efficient operation of a ventilated dry kiln is concerned? It means this: First, we must use moderate dry-bulb temperatures in kiln drying stock green from the saw until the free water has been evaporated, otherwise honeycomb may develop in the more refractory woods. Second, as the condition is reached where the core of the lumber is near the fiber-saturation point, the dry-bulb temperature may be cautiously raised. Third, when most of the pieces in the kiln charge no longer contain free water, the accelerating point, as far as the dry-bulb temperature is concerned, is reached and the dry-bulb temperature can be boosted.

Our present schedule recommendations reflect this approach, but we stop at 180° F. except for certain schedule recommendations for the softwoods. Higher final dry-bulb temperatures than 180° F. can be used on hardwoods if strength properties are not particularly important. Use our "T" schedule recommendations of report D1791 as a starting point, but explore the possibilities of using a higher T number. Our schedule recommendations provide a conservative estimate of the critical temperature for the various species, but the particular wood being dried may have an appreciably higher critical temperature, for this varies considerably within and between species. Also use final dry-bulb temperatures higher than 180° F. if the use of the wood is not greatly influenced by some strength reduction. During high final temperature operation, radiation losses from the kiln may be greater than if lower dry-bulb temperatures are used, but because of the increased drying rates, kiln output will be greater and the radiation losses per 1,000 board feet of lumber dried will actually be less.

These high final temperatures were often used in the old hot boxes, and drying was rapid and successful. Trouble developed, however, when partially dried or green hardwoods were put into these kilns. The critical temperature was exceeded and serious honeycomb often developed. Fast drying should be done using high dry-bulb temperatures when it is safe to do so. We are recommending a dry-bulb schedule that is essentially a two-stage proposition, namely, the use of moderate temperatures when the stock contains free water and the use of elevated temperatures when the free water has been evaporated. Some of our hardwoods are being successfully kiln dried at dry-bulb temperatures above the boiling point of water after the stock has first been air dried to a moisture-content condition such that no free water is present. This is the way to get fast drying of the hygroscopic water, but the kiln should be well-insulated, with infiltration and exfiltration heat losses kept to a minimum.

We are hearing much about the Hildebrand kiln and its accomplishments as to reduced drying time. It uses the principles just described in an internal-fan ventilated dry kiln that is very tight and exceptionally well insulated. On woods that have very high critical temperatures, it uses superheated steam drying in the initial stages to control checking and splitting and then finishes the kiln run at the same or higher dry-bulb temperatures and very low relative humidity. So much for the acceleration of the drying of wood by means of elevated temperatures. We will see more and more of our hardwoods being kiln dried at high final temperatures, and to so dry them will mean that more attention must be paid to ways and means of keeping steam consumption down. This will call for the constant attention of the kiln operator and the exercise of his ingenuity in using the ventilated kiln to the benefit of the plant owner.

Humidity Control Factors

The relative humidity accelerators poses a very interesting situation. Whereas the elevation in dry-bulb temperature speeds up the diffusion of moisture through the wood, the reduction in relative humidity sets up the potential or moisture gradient which causes diffusion to take place. Wood can be heated to rather high temperatures without much drying taking place if the relative humidity is kept quite high. To obtain fast drying with the heat made available, the relative humidity should be maintained at low values consistent with the control of surface and end checking. What is in-

volved and how can the humidity schedule be adjusted to gain fast drying safely and yet conserve steam? Somewhat the same situation exists here as with the dry-bulb temperature accelerator but in a reverse sense. In the initial stages of drying green stock, the relative humidity must be kept reasonably high to prevent end and surface checking. After a relatively short period of drying, the relative humidity can be dropped, sometimes very rapidly, to rather low values and maintained there to evaporate the balance of the free water and the hygroscopic water.

Split Schedules

It was obvious that our former concept of a drying-schedule pattern had to be changed. Many of the available schedule recommendations are in the form of a combined temperature and relative humidity schedule tied in with the moisture content of the wood. A favorite type of schedule is one that uses the same wet-bulb temperature throughout the kiln run with increasing temperature as the wood dries, which automatically reduces the relative humidity as the temperature is raised. We had to split the temperature schedule and the humidity schedule in order to take advantage of the fact that the relative humidity can be lowered much sooner than the dry-bulb temperature ordinarily can be increased. The splitting of the temperature and humidity schedules and giving independent recommendations based on moisture content of the stock introduces a novel scheme which will prove helpful to the kiln operator. Instead of having one humidity schedule tied in with moisture content which could be used with different temperature schedules, we have in actuality 48 different combinations of humidity schedules which can be combined with 13 temperature schedules.

The A to F humidity schedules in our report D1791 are designed to provide different humidity schedules for woods of high and low green moisture content. For woods like Douglas-fir, having a low green moisture content, the A or B humidity schedules are used, whereas those woods which have a much greater green moisture content can be dried with the D, E, or F humidity schedules. This sort of schedule splitting was done because the relative humidity can be dropped after about one-third of the free water has been evaporated. Studies have shown, in kiln drying hardwoods green from the saw, that when this stage is reached the relative humidity can be reduced without the likelihood of any new checks developing. The tension stresses on the surfaces are subsiding. The stock has been set in tension or case-hardened.

Unfortunately, we are not now in a position to say just how fast the relative humidity can be decreased as the stock dries, but the humidity schedules in D1791 provide a pattern that we feel is conservative. You may not all agree, as in some cases the relative humidity seems to be quite low when the average moisture content is still well above the fiber-saturation point. Note that in the final stages of drying we suggest a 50° F. depression. This is tantamount to saying that when drying has proceeded to the point where a 50° F. depression can be used, relative humidity control, as such, is not necessary. When the desired moisture level is reached, the kiln charge is placed on equalization, if necessary, and finally conditioned if stress relief is essential.

Humidity Control Saves Steam

The recommended humidity schedule offers the operator an opportunity to save steam. If the vents are tight and infiltration of air kept to a minimum, the desired wet-bulb temperature can be maintained without the use of steam for the spray. The vent controller should be adjusted and the instrument tuned so that only enough venting takes place to get rid of the water being evaporated. If venting is excessive, steam will be required for humidity control, and this I feel is a wasteful procedure. I contend that a ventilated kiln should and can be operated in such a manner that steam for wet-bulb control is needed only during the equalization and conditioning process. During the drying cycle, the desired control of the wet-bulb should be obtained through vent control only.

Before leaving the subject of drying schedules, I want to make a plea that you do not consider our schedule recommendations a cut-and-dried proposition. It is easy to take our suggestions for a drying schedule and work out the temperature and humidity steps, and then, when it is found to be quite satisfactory, to sit back and use the same schedule over and over again. Our recommendations as to drying schedules for the different species and items must be on the safe or conservative side. The split-schedule recommendation, however, offers a great opportunity for individual kiln operators to modify the schedule being used to speed drying and to better fit the actual schedule to the seasoning characteristics of the species and item being kiln dried; therefore, our recommended schedules should be considered as a starting point. The seasoning characteristics of wood vary tremendously within species, and the operator who is on his toes will take every advantage he can to manipulate the schedule to get faster drying without increasing seasoning losses. If, for example, we recommend temperature schedule T6 and you consistently have no evidence of honeycomb, temperature schedule T8 should be tried. If you are using humidity schedule D3 and checking is not a problem, try humidity schedule D4. The next step toward speeding up drying by humidity-schedule modification is to try humidity schedule E4. By all means don't be satisfied with our basic recommendations, for the temperature and humidity schedules are patterned to provide flexibility and adaptability. To improve the performance of your ventilated kiln, it is essential that you experiment with schedule modifications.

There are other measures of kiln performance than energy consumption. Stock must not only be dried with a minimum of power and steam costs, but seasoning defects and warp must also be at a minimum. To waste wood at the expense of energy conservation would obviously be uneconomical. The stock must be dried to desired levels of average moisture content, over-all uniformity, and stress freeness. My concern here today has been with energy conservation, and I hope I have interested you in giving some thought to this matter. Your ventilated kiln is not an obsolete kiln type, but I am sure that you can get more value out of the fuel you use.

"AGE OF WOOD" FORECAST BY CANADIAN

At the recent joint meeting of the Canadian Institute of Forestry and the Society of American Foresters, in Montreal, Hon. Robert Winters, Canadian Minister of Resources, noted that many research scientists held that "**the future will see wood used in a multiple of ways and forms that are scarcely realized today.**"

Air Seasoning of Lodgepole Pine Poles[1, 2]

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Methods of testing moisture content of poles, various methods of piling for air drying and determination of circumferential shrinking during drying are described. With open piling, as in illustrated pile "one," moisture reading near edge of pile gives a fairly accurate indication of moisture content throughout pile.

IN COOPERATION with the J. Neils Lumber Co., Libby, Mont., the U. S. Forest Products Laboratory studied the air seasoning of lodgepole pine poles. The purposes of this work were: (a) to investigate the practicability of using a resistance type of electric moisture meter for determining moisture-content average and distribution in lodgepole pine poles just before preservative treatment; (b) to determine the effects of different methods of piling; and (c) to determine the circumferential shrinkage of lodgepole pine poles during air seasoning.

Material

There were 2,161 class-7, 30-foot lodgepole pine poles used in this investigation, all cut from trees growing within a 40-mile radius of Libby, Mont. The poles were trucked to the treating plant and were machine-peeled before being piled for air seasoning. The interval between the felling of the trees and the arrival of the poles at the plant was about 1 week.

Procedure

Foundations and Piles

Timber foundations about 18 inches high and 6 feet apart were provided for the experimental seasoning files, between 30-foot front and rear alleys (Fig. 1).

Three piles of poles were erected during a 3-week period beginning July 28, 1950.

In pile 1, two 8-pole layers were placed at right angles to each other on the foundation, 40 poles in the third layer, 8 poles in the fourth layer, 40 poles in the fifth layer, and so on until 21 layers were completed. This pile may be designated as a modified crosshatch pile (Figs. 2 and 3).

In piles 2 and 3, each layer consisted of about 40 poles, piled at right angles to the layer below, and each pile had 21 layers. Both piles were of the so-called crosshatch type (Figs. 4 and 5). Pile 4 was covered with a pitched roof consisting of two layers of boards separated by a layer of building paper (Fig. 5).

Sample Poles and Electrodes

Twenty sample poles for each pile were weighed, and their lengths and circumferences at the top, ground line, and butt were measured before and after air seasoning. The original weights and measurements of the sample poles were recorded on the following dates: Pile 1, July 27 to 29, 1950; pile 2, Aug. 2, 1950; pile 3, Aug. 7, 8, and 10, 1950. The final weights and measurements were recorded on the following dates: Pile 1, July 12 and 17, 1951; pile 2, July 14 and 20, 1951; pile 3, July 20, 1951. In each pile, four of these sample poles were placed in each of five layers, as shown by the white crosses in Figures 3, 4, and 5. In each sample pole before placement in the pile, two brass escutcheon pins were driven to a depth of about 1¼ inches or 0.15 of the di-

Figure 1.—Pier-and-beam timber foundation for experimental pile of lodgepole pine poles.

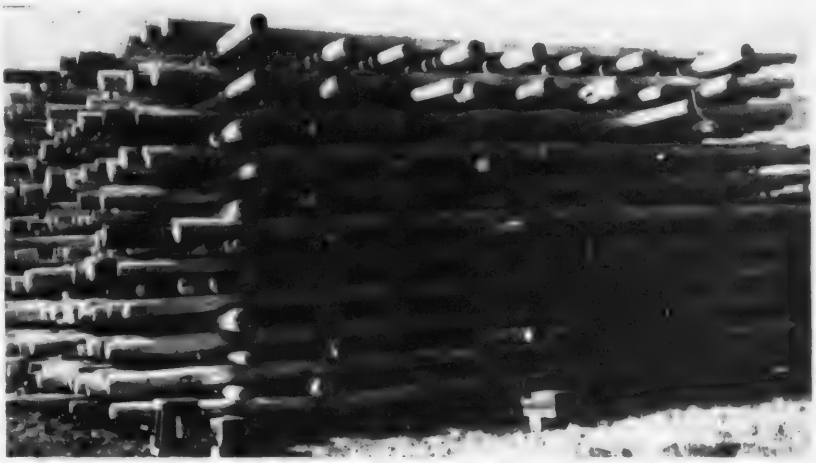

Figure 2.—Cornerwise view of modified-crosshatch pile 1 showing ends of 8-pole layers.

[1] Condensed from Forest Products Laboratory Report No. R1922.

[2] The author acknowledges his indebtedness to M. R. Knudson and to G. D. Bowen, of the J. Neils Lumber Co., Libby, Mont., for their effective cooperation, which was very essential to the conduct of this work.

[3] Maintained in cooperation with the University of Wisconsin at Madison, Wis.

ameter at the ground line. (This depth[4] corresponds theoretically with the depth at which the average moisture content occurs when the average moisture content does not exceed about 40 percent in the case of lodgepole pine.)

[4] For further details see the complete report, No. R1922.

The escutcheon pins were 0.108 inch in diameter. No. 20 enameled copper wires were soldered to the pins and were connected through jack boxes to an electric moisture meter of the resistance type shown in Figure 6.

Moisture-meter readings were recorded at intervals of 10 to 20 days during the air seasoning period, except that only one reading was taken during November, and none during October, December, January, and February, because readings taken at low temperatures and at high moisture-content values are not very reliable. An approximate rule to correct meter readings for temperature is to add ½ percent for each interval of 10° below 70° F., and to subtract ½ percent for each interval of 10° above 70° F.

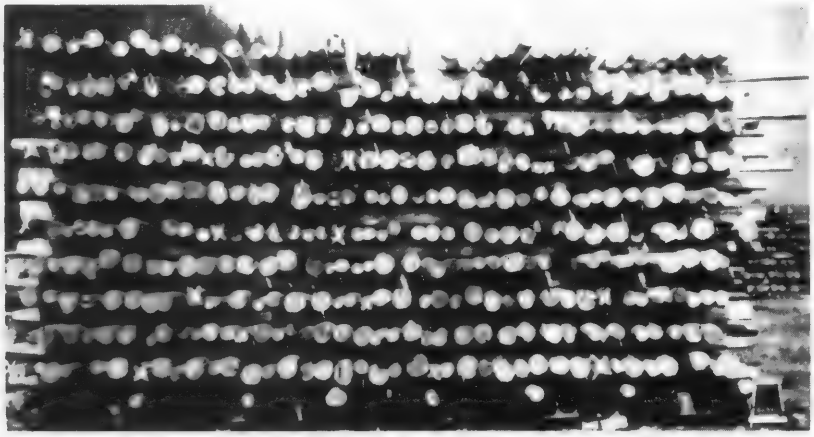

Figure 3.—View of modified crosshatch pile 1 showing four sample poles (indicated by white crosses) in each of five 40-pole layers.

Figure 4.—View of crosshatch pile 2 showing sample poles.

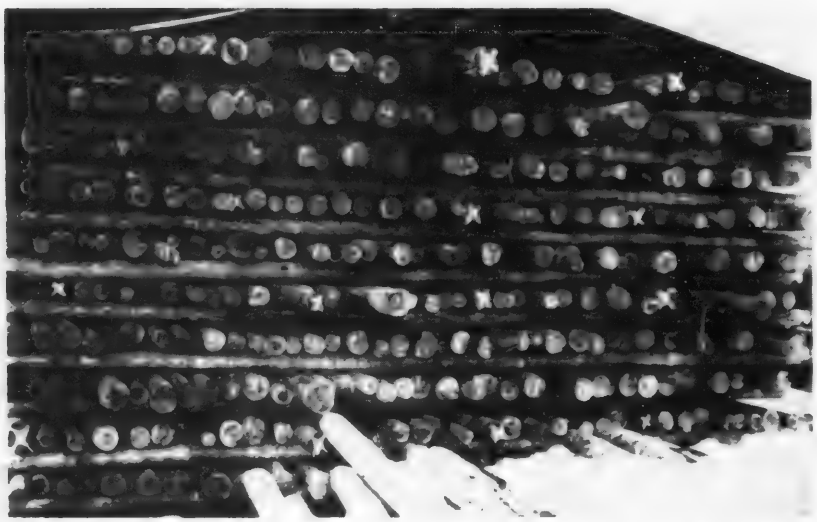

Figure 5.—View of roofed crosshatch pile 3 showing sample poles. (Six of the sample poles in the pile do not appear in the photograph.)

As each pile was razed, a moisture-meter reading was taken with the pins of a special electrode driven to a depth of 1¼ inches at the ground line in each pole. Moisture-meter readings were taken later at the following depths at the ground line in each air-seasoned sample pole: ⅜, 1, 1¼, 1½, and 2½ inches.

From each of 10 air-seasoned sample poles from each pile, a 1-inch disk was cut at the ground line. Each disk was cut into three rings and a core, as shown in Figure 7, for determination of moisture-content distribution by the oven-drying method. The average depth of each ring corresponded to the depth (⅜, 1, or 1½ inches) at which a moisture-meter reading had been taken for comparison.

The computed depth at which the average moisture content of the above-mentioned cores occurred was about 2½ inches from the surface of the poles, which were 30-foot, class-7, having an average ground line diam-

Adjacent to each disk cut for moisture-content distribution, a 1-inch disk was cut for the determination of average moisture content by the oven-drying method, (see Fig. 7).

On the basis of initial and final weights per cubic foot and of final moisture content (determined by the oven-drying method), the oven-dry weight per cubic foot and the initial moisture content were calculated for each of the three piles.

In pile 2, blue stain, mostly heavy in the lower half of the pile, occurred

Figure 6.—Jack boxes through which wires from electrodes in sample poles were connected to the moisture meter at right side of illustration.

in all layers except layers 16, 18, 20, and 21. The 4 or 5 poles nearest the faces of the piles and in the first 13 layers appeared to be practically free from stain and mold, presumably because of more rapid drying of these poles. Mold occurred in layers 2 to 11, and orange stain occurred in layers 3 to 7, and in 9 to 11.

In pile 3, blue stain, moderate to heavy in the lower half of the pile, occurred in all layers except layers 20 and 21. The 2 to 10 poles nearest the faces of the pile and in the first 18 layers appeared to be practically free from stain and mold. Mold occurred in layers 3 to 17, and orange stain in layers 5 to 17.

After air seasoning, all poles in the three piles were pressure-treated with creosote to a net retention of about 8 pounds per cubic foot. Borings taken from 20 treated poles from each pile showed that the sapwood was completely penetrated by the preservative. The sapwood depth varied from 0.6 to 2.1 inches and averaged about 1.3 inches. The area of the sapwood was about half that of the cross section. The penetration into the heartwood beneath the sapwood averaged 0.2 to 0.4 inch for the different groups of poles.

Discussion of Results

Figure 8 shows the general trend in the drying of the sample poles in each of the three piles. The moisture meter used was inherently less accurate at moisture-content values higher than the fiber-saturation point than it was at lower moisture-content values. For this investigation, however, such a characteristic was not very detrimental. Readings on the samples in pile 3 were delayed until Sept. 6, 1950, because a jack box was not available until that date.

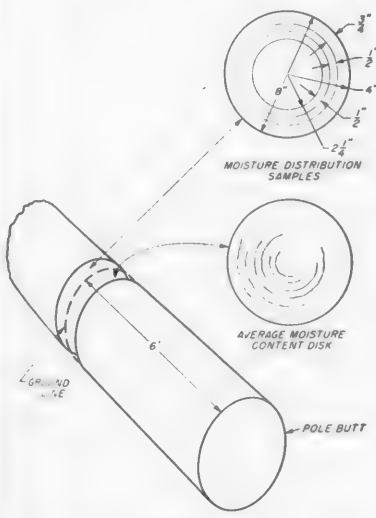

Figure 7.—Sketch showing at several depths disks for determination of moisture content by the oven-drying method. Mid-points of zones in one disk correspond to points at which moisture meter readings were taken. Other disk was for determination of average moisture content.

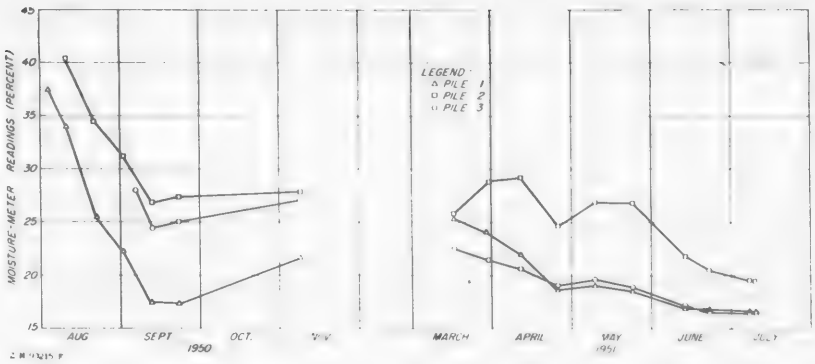

Figure 8.—Moisture-time curves based on average of moisture-meter readings taken with escutcheon pins at a depth of 1¼ inches in 20 lodgepole pine poles in each of 3 piles.

Table 1 --Comparison between moisture-meter readings taken at 1-1/4-inch depth at the ground line in each of 10 sample lodgepole pine poles from each of piles 1 and 2, and of 9 poles from pile 3, and average moisture-content values determined by the oven-drying method, July 1951

Pole number (1)	Moisture-meter readings moisture content (2)	Entire cross section moisture content (3)	Column 2 minus column 3 (4)
	Percent	Percent	Percent
	Pile No. 1		
	July 12, 1951	July 12, 13, 1951	
9	18.0	18.9	- 0.9
11	20.0	19.5	.5
12	22.5	19.1	3.4
13	19.5	21.7	- 2.2
14	20.5	16.5	4.0
16	18.0	17.2	.8
17	28.5	24.7	3.8
18	22.0	24.4	- 2.4
19	21.5	31.7	-10.2
20	20.5	18.9	1.6
Aver.	21.1	21.3	.....
	Pile No. 2		
	July 14, 20, 1951	July 16, 21, 1951	
22	23.0	23.6	- .6
23	22.0	23.0	- 1.0
24	23.5	25.4	- 1.9
27	28.0	31.9	- 3.9
28	25.0	25.9	- .9
29	20.0	17.5	2.5
30	26.0	22.5	3.5
31	25.0	23.7	1.3
32	23.0	21.4	1.6
37	21.5	24.2	- 2.7
Aver.	23.7	23.9	.....
	Pile No. 3		
	July 20, 1951	July 21, 23, 1951	
42	23.5	21.2	2.3
50	17.5	18.3	- .8
53	18.0	20.9	- 2.9
54	17.5	17.6	- .1
55	18.0	17.5	.5
57	13.0	13.9	- .9
58	16.5	13.8	2.7
59	15.0	14.3	.7
60	13.0	18.3	- 5.3
Aver.	16.9	17.3	.....

During the early stage of drying, the more rapid rate of drying of the sample poles in pile 1 as compared with those in piles 2 and 3 is apparent, although a part of the difference is

due to the fact that the sample poles for pile 1 were prepared about 5 days before those in pile 2 and 11 days before those for pile 3. The result is attributed principally to the fact that the poles in pile 1 were somewhat more open-piled than those in the two other piles and that the method of piling permitted a more rapid movement of air through pile 1.

Initial Variations

While the initial average moisture content of the 10 sample poles in pile 2 was somewhat higher than that of the corresponding poles in pile 1, this factor alone would theoretically have relatively little effect on the drying rate. That this is true is indicated also by the fact that the initial average moisture-content values of the sample poles in piles 1 and 3 were practically the same, and, as previously mentioned, the differences in drying rates among the piles during the early stage of drying were mainly attributable to the methods of piling.

The upward trend in the curves during the fall and winter was due to the higher relative humidities and increased precipitation.

Referring to Table 1, it may be noted that: (a) in pile 1, the moisture-meter readings with one exception varied from 2.4 percent lower than to 4.0 percent higher than the values determined by the oven-drying method, and the averages (respectively 21.1 and 21.3 percent) were practically the same, within the limits of accuracy of the methods; (b) in pile 2, the corresponding range was from 3.9 percent lower than to 3.5 percent higher than the values determined by the oven-drying method, and the averages were respectively 23.7 and 23.9 percent; and (c) in pile 3, with one exception, the moisture-meter values varied from 2.9 percent lower than to 2.7 percent higher than the values determined by the oven-drying method, and the averages were respectively 16.9 and 17.3 percent.

Satisfactory Depth

The average moisture content for each pile, as shown in Table 2, compares well with the tabulated value obtained at the 1¼-inch depth, and indicates the consistency of the moisture-meter readings. Moreover, when these average values are compared with those in Table 1, it appears that generally the moisture-meter reading taken at the 1¼-inch depth, i.e., at 0.15 of the diameter, is a satisfactory indication of the average moisture content, at least when the average moisture content is below the fiber-saturation point and when there is no pick-up on the surface.

Table 2 --Moisture-meter readings taken at 1-1/4-inch depth at the ground line in each of 10 sample lodgepole pine poles from each of piles 1 and 2, and of 11 poles from pile 3, July 1951

Pile 1		Pile 2		Pile 3	
Pole Number	Moisture-meter readings	Pole Number	Moisture-meter readings	Pole Number	Moisture-meter readings
	Percent		Percent		Percent
1	23.0	21	22.0	41	21.0
2	20.8	25	20.5	43	24.0
3	23.5	26	20.5	44	24.0
4	23.0	33	17.5	45	20.5
5	20.0	34	22.0	46	25.0
6	20.5	35	20.5	47	21.5
7	17.5	36	21.0	48	20.0
8	23.0	38	38.0	49	22.0
10	22.5	39	22.0	51	18.0
15	21.5	40	22.5	52	20.0
				56	17.5
Av.	21.3	.....	23.2	.....	19.3

Table 3.--Average moisture-meter distribution readings taken on 20 air-seasoned lodgepole pine poles in each of 3 piles, July 1951

Depth	Pile 1		Pile 2		Pile 3	
	Moisture content	Proportionate area[1]	Moisture content	Proportionate area[1]	Moisture content	Proportionate area[1]
In.	Percent	Percent	Percent	Percent	Percent	Percent
3/8	14.1	33.1	14.8	33.1	13.3	32.9
1	19.5	18.4	21.6	18.4	18.0	18.3
1-1/4	21.3	.....	23.2	.....	19.3	.....
1-1/2	22.3	15.4	24.7	15.4	20.4	15.4
2-1/2	26.6	33.1	30.9	33.1	24.1	33.4
Weighted average moisture content	20.5	.....	22.9	.....	18.9	.....

[1] The proportionate area is the percentage of the total cross section represented by the respective areas of the 3/4-inch, 1/2-inch, and 1/2-inch annuli, and of the core. For example, if the area of the total cross section is 53.3 square inches and that of the outer 3/4-inch annulus if 17.6 square inches, the proportionate area is 17.6/53.3, or 33.1 percent.

In Table 3 the average moisture content of four or five poles in the outside tier may be compared with that of corresponding poles in a centrally located tier in each pile. The respective differences in average moisture content between the two groups of poles are 1.1 percent for pile 1, 10.4 percent for pile 2, and 5.2 percent for pile 3. Especially in the case of pile 1 does it appear that the moisture-meter readings of the accessible poles of an outside tier may be used as an indication of the moisture content of poles open-

piled as they were in pile 1. With close piling, as in piles 2 and 3, the spread in moisture-content values was considerably greater than that in pile 1 on Sept. 12, 1950.

On the basis of readings taken during July 1951, the averages shown in Table 3 are perhaps 2 to 5 percent lower than the true averages determined by the oven-drying method. Possibly the checking around the escutcheon pins had a greater effect on contact resistance than that around the special electrode, driven only a moment before the readings were taken. The increased contact resistance of the escutcheon pins would result in lower moisture-meter readings than those taken with the special electrode.

In addition to the readings taken at the ground line in each of the poles in the central tier in each pile, similar readings were taken also at the midlength. On Sept. 12, 1950, the average moisture-content values were about 1 or 2 percent higher at the midlength than at the ground line, indicating slightly slower drying near the middle of the pile than at 6 feet from the side of the pile.

The markedly smaller amount of stain and mold in pile 1 as compared with that in piles 2 and 3 is further evidence of the more rapid drying of pile 1.

The data from this study are not sufficiently complete to provide a basis for stating the maximum moisture content at which lodgepole pine poles can be pressure-treated with creosote although the penetration measurements taken after treatment indicated that the poles were dry enough to take good pressure treatment. It may be mentioned, however, that, theoretically, with a uniform moisture content of 80 percent in the sapwood, the air space in lodgepole pine is ample to permit a retention of 8 pounds of creosote per cubic foot. Treatment at such a high moisture content, however, would be objectionable because, subsequently, checking would occur and might expose untreated wood to fungus attack. This consideration is of far greater importance than the determination of the maximum moisture content at which the wood can be satisfactorily treated. How low the moisture content should be at the time of treatment to prevent objectionable subsequent checking is not known. Until relevant data are obtained, it is believed that the average moisture content of lodgepole pine poles should not exceed about 30 percent at time of treatment.

Table 4, which is based on moisture-meter readings, shows, with the exce-

Table 4.--Average, maximum, and minimum moisture-meter readings taken with escutcheon pins at a depth of 1-1/4 inches at the ground line in an outside tier and in a centrally located tier of poles[1] in each of three piles on Sept. 12, 1950

Pile Number	Moisture content						Difference in averages
	Outside tier			Central tier			
	Average	Maximum	Minimum	Average	Maximum	Minimum	
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
1	16.9	17.5	16.0	18.0	24.0	12.5	1.1
2	20.2	24.0	17.0	30.6	42.0	18.5	10.4
3	20.0	23.0	17.5	25.2	26.0	23.5	5.2

[1] Five poles in each tier in piles 1 and 2. Four poles in each tier in pile 3.

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Table 5.--Variation in moisture content based on moisture-meter readings taken on a total of 2,125 lodgepole pine poles in 3 piles, July 1951

Pile number	Portion of pile	Average of moisture-meter readings	Standard deviation	Moisture-meter readings	
				Minimum	Maximum
		Percent	Percent	Percent	Percent
1	Top third	19.5	2.50	15.5	28
	Middle third	17.8	1.31	14.0	24
	Bottom third	17.8	1.67	13.0	23
	Average	18.4	2.03		
2	Top third	20.1	2.58	14.5	30
	Middle third	21.9	3.04	16.0	40
	Bottom third	23.2	4.89	16.0	55
	Average	21.7	3.86		
3	Top third	16.9	2.35	11.5	26
	Middle third	19.7	2.01	15.5	28
	Bottom third	21.1	2.41	15.0	33
	Average	19.3	2.85		

Table 6.--Average circumferential shrinkage of 8 or 10 class 7, 30-foot lodgepole pine poles from each of 3 piles during air seasoning

Pile number	Average moisture content[1]		Circumferential shrinkage		
	Initial	Final	Top	Ground line	Butt
	Percent	Percent	Percent	Percent	Percent
1	77.1	21.3	1.9	1.2	1.3
2	93.9	23.9	1.5	.8	1.2
3	75.8	17.3	1.9	1.4	1.5

[1] Based on initial and final weights per cubic foot and on final moisture content of 8 or 10 sample poles from each pile.

tion of pile 1, an appreciable increase in moisture content from top to bottom, as would be expected because, when a pile is drying, the principal air movement is downward through the pile. In pile 1, however, the top third had the highest average moisture content, probably because of the rain on the day preceding the date on which the readings for pile 1 were taken. That the drying of the poles in pile 1 was more nearly uniform than in piles 2 and 3 is indicated by the fact that the standard deviation was the smallest for pile 1. Further, the lower average moisture content and smaller standard deviation for pile 3 than the corresponding values for pile 2 indicates some benefit from the roof on pile 3. Nevertheless, the difference in moisture-content values between piles 2 and 3 does not appear to justify the use of the roof on pile 3. A roof over piles of type 3 might be found more advantageous than over piles like 2 or 3.

Referring to Table 5, it may be noted that the average circumferential shrinkage was less at the ground line than at either the top or the butt. One explanation is that the top and butt ends were probably drier than the ground-line section and therefore had the greater shrinkage. Furthermore, the greater shrinkage at the top than at the butt may be accounted for on the assumption that the top, being smaller, was drier than the butt. As would be expected, in a general way the shrinkages increased as the moisture content decreased. Because of irregularities in shape at the top and butt, it is probable that measurements taken at the ground line are more reliable than those taken at the top and butt. As the moisture content approached 20 percent, the circumferential shrinkage at the ground line was about 1.3 percent of the circumference when the poles were green.

The resistance type of electric moisture meter used in this study was found to be a satisfactory means of determining moisture-content average and distribution in class 7, 30-foot lodgepole pine poles, at least when the average moisture-content values do not exceed 30 percent (Fig. 10). The average of moisture-meter readings taken at a depth of 0.15 of the diameter at the ground line checked well with the average of moisture-content values determined by the oven-drying method (Table 2). It should be a satisfactory instrument to use, therefore, in studies aimed at finding the optimum range of moisture-content for treating lodgepole pine poles by either pressure or non-pressure methods.

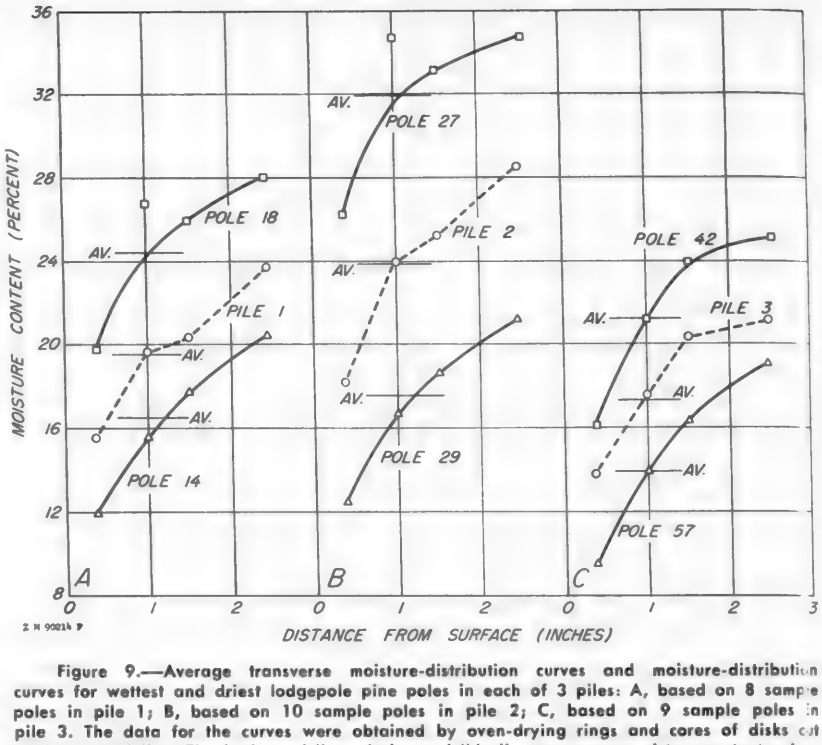

Figure 9.—Average transverse moisture-distribution curves and moisture-distribution curves for wettest and driest lodgepole pine poles in each of 3 piles: A, based on 8 sample poles in pile 1; B, based on 10 sample poles in pile 2; C, based on 9 sample poles in pile 3. The data for the curves were obtained by oven-drying rings and cores of disks cut at the ground line. The horizontal lines designated "Av." are average moisture-content values based on oven-drying determinations, using whole disks cut adjacent to those used for the determination of moisture-content distribution.

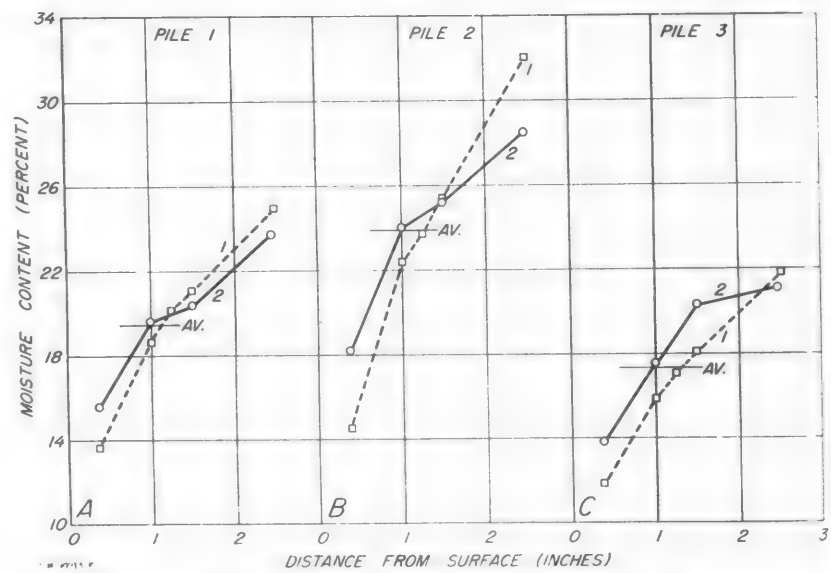

Figure 10.—Average transverse moisture-distribution curves for lodgepole pine poles: A, based on 8 sample poles from pile 1; B, based on 10 sample poles from pile 2; C, based on 9 sample poles from pile 3. Curves 1 and 2 in each figure are based respectively on moisture-meter readings and on oven-drying determinations. Curves 2 are the same as the average curves in Figure 9: A, B, and C. The horizontal lines designated "Av." are average moisture-content values based on oven-drying determinations, using whole disks cut adjacent to those used for the determination of moisture-content distribution.

Quality Control of Veneer and Plywood Manufacture[1]

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One purpose of quality control is to maintain a desired standard of quality in products produced. Adaptation of general principles to a specific plant and specific production problems, resulting in better product quality control, is described. Control methods also help reduce waste.

QUALITY CONTROL is a term which has several shades of meaning. To anyone engaged in any type of manufacturing, quality control is simply the means employed at present in maintaining a desired standard of quality in the products produced. In this concept of quality control, the means employed are not emphasized, and in a particular plant any means will suffice so long as the desired results are attained.

Now, just as there has been some professional thought given to such things as cost control, safety, job classification, plant layout, and so on, applicable to any industry, there have also been developments of a professional nature in the field of quality control. As with the fields mentioned above, application of the general principles must be adapted to conditions existing in a particular industry and a particular plant.

The professional knowledge in quality control that has been accumulating in recent years has drawn rather heavily on the field of mathematical statistics. The techniques employed have been developed and simplified so that they may be applied in the plant without much time consumed in the statistical work.

An important point worth emphasizing in any quality control system is that the responsibility for quality rests ultimately upon the man doing the work. A large force of police type inspectors is not necessary. Quality mindedness must exist in the entire organization and must be reflected in the physical plant and in the methods established.

In our company, the management establishes the average quality levels as targets and expect production to maintain these levels. The quality control department measures the performance to see that the standards are met, informs production when the standards are not met, and informs management when action by production fails to produce the desired quality levels. In addition, the quality control department keeps running records of various quality measures to keep management and production informed of performance with respect to quality, so that appropriate action may be taken when necessary. It is the fault of production when defectives are produced, and it is the fault of quality control when defectives are not reported and when they are not reported commensurate with the seriousness of the situation. The timing and manner of reporting quality performance must be done in such a way as to produce appropriate action.

It is my purpose here to discuss merely some of the places in our veneer and plywood operation where statistical quality control records are used to advantage.

Veneer Thickness

In our veneer plant, thickness is regarded as very important. Lathe operators and slicer operators are provided with dial micrometers and thickness is checked frequently by the operators. In spite of this precaution, however, we have found thick and thin veneer in the plywood plant, and even in the plywood itself. The consequences of thick and thin veneer are serious enough to warrant a separate check on this property.

At approximately hourly intervals a quality control inspector measures the thickness of five sheets of veneer from the same log, and records his readings on a data sheet. The quality control man then calculates the average of the five readings, and the range, which is the difference between the largest and smallest reading. This is the extent of the statistical calculations, which are quite simple. The values of the average and the range obtained at a particular check are plotted on a chart conspicuously displayed on the wall nearby. A sepachart and data sheet is kept for each nominal thickness.

This chart has limit lines drawn on it within which the average and range should fall. These limits have been computed in a very simple way from previous data. When a point falls within the lines, there has been no significant shift in average value of the thickness, based upon the inherent variation in the process which has been previously studied and incorporated in the limits. Also, there is an indication that the variability is no worse than it has been in the long run. In other words the values of the average and range obtained at a particular time could just as well have been obtained by chance at some previous time. Consistent plotting of average and range within limits indicates a condition which is described as being in control.

Thickness of veneer at the lathe has been proved to be capable of being in a state of control. Most of the time we find nothing the matter with our charts on green thickness. Occasionally, however, we have found some long term shifts in average, faulty machine setting, faulty equipment, and so on. Infrequent as these occasions have been, they have indicated trouble when it arose, and they have pointed the way to keeping thick and thin veneer from entering the plywood plant. An out-of-control point at the lathe is followed up by an intensive search for thick and thin veneer at the offbearing end of the dryer where sorting, scrapping, and reclipping are used to keep the thickness uniform. The cost of keeping the record has probably been justified in these situations, but the record is worthwhile anyway to keep track of what is going on in this vital part of our process.

Charts similar to those described for the lathe are kept at the slicers. On thin sliced veneers the variation in thickness is not sufficiently wide when measured with a micrometer calibrated in thousandths of an inch, to match the usual quality control methods that have been developed theoretically. We feel that the chart type record is worthwhile, so some modification has been made of the standard practice with our slicer charts.

Moisture content of veneer is an important property of the material.

[1] Presented at meeting of the Forest Products Research Society, Deep South Section, November 7, 1952, Baton Rouge, La.

Although moisture content can be made to be in a state of control, we find it difficult to maintain this state in the long run; and for some logs this ideal state is practically impossible. Actually the control chart, though simple, is a very sensitive device, and any deviation from a constant system of chance causes will be picked up by the chart. Here is a case where some modification in the way of figuring limits may be justified because of the inherent variation in properties affecting the drying rate which vary from one piece of wood to the next, and especially from log to log. Our present practice at the veneer driers is to take a sheet of veneer, clip it in to four parts and then clip each part in to several small pieces for ease in handling. Moisture contents are obtained by the oven method using a relatively hot oven. The average and range of the four readings are obtained and plotted on the chart. Out of control situations are reported to the foreman for correction. Recommended set-up conditions are posted on each drier.

Squareness

Veneer should be clipped with parallel edges and square corners. This is especially true for veneer cores and cross bands. Out of square part pieces cause rainbow shaped cores which result in obvious difficulties in plywood manufacture.

As the part pieces are clipped the difference in width at each end is measured and recorded. Also the amount out of square is measured for each clipped edge. The difference in width we call taper and it is always measured as the width of the piece on the end toward the operator minus the opposite end. Four pieces are measured each check and the largest and smallest difference values are plotted on a chart. Points on such a chart should fall within limits and average zero. A similar chart is kept for the largest and smallest squareness readings from the eight squareness readings taken on the four veneer sheets checked. Limits are put on this chart and pieces of veneer corresponding to points out of limits are given back to the operator for reclipping and the foreman informed.

Veneer Waste

The techniques developed for controlling quality are also applicable to other phases of a business. It has been said that the field of statistical quality control is becoming even broader in scope than the general, every day meaning of quality control because of the wide field to which the techniques have been applied.

In our veneer plant we are interested in controlling waste, as is everyone else. In addition to the usual over-all measures of waste, we keep track of the waste at various specific operations. Charts are kept at several clippers and at the saw used to cut sliced veneer to length. These charts serve as a psychological incentive to the operators to do good work. The charts also give a clear picture of the waste as it occurs.

As an example, we keep such a chart posted at the clipper which trims purchased rotary cut veneer. Here three sheets of veneer are measured before and after clipping. The difference is waste and the average waste for the three sheets is plotted on a chart located in a conspicuous place near the clipper. This clipper is located in a place removed from the general activity of the plant, and the chart has served as an incentive to reduce the waste, as the average waste per piece dropped from about two inches to about one half inch.

On sliced face veneer the waste strips resulting from one cut of the knife are collected and four selected for measurement. Measurement is from the knife cut to the defect, which, for example, may be a knot, split, sap, some figure in the wood which may be removed. etc. The average of the four strips is plotted on a chart. Since this chart was put up, an improvement in the waste at this clipper has been noticeable. Also we have a record of the defects which cause unusual amounts of waste and this information is put to good use.

Plywood

In the actual production of plywood at the hot presses there is very little spot checking by the quality control deparment. In our operation the changes in the material run are frequent so that here production gets little help from occasional spot checks. The quality control department tabulates a running record of the glue spread which is given to proper authorities at regular intervals.

At the plywood press there are posted charts for various plywood defects which can originate there. These defects include blown panels, overlaps, short veneer and pieces broken out. These defects are tallied at the plywood grader's cull pile. We also calculate over-all plywood the percent defective and post this figure on charts at the press and near the grading operation.

The defects are carefully studied and summarized weekly. Defects are classified by type and also by probable source. Money lost for each defect seen and for each probable source is calculated and incorporated in the weekly report. This report serves as basis for action to reduce defects to a practical minimum.

Shear Tests

Shear tests are made on all waterproof constructiosn and the shear strength and wood failure values are recorded. Specimens are tested according to the specifications appropriate for the particular order sampled. Sampling in this way serves as a check on the general performance of the bonding of the plywood and also allows us to keep the plywood sampled from being shipped, should that action be indicated as necessary from the test results.

Conclusions

In general the quality control department has assisted production in areas where spot check methods and statistical methods appear to be worthwhile, although responsibility for quality still rests with production, management feels that the quality control department is paying its way. As conditions change and as improvements are made, quality control shifts its activities to meet the current needs. Problems in any two plants are never the same, but some of the methods found in quality control literature certainly are applicable to many problems in any particular plant.

WHEN SHOULD RESEARCH BE UNDERTAKEN?

"Before undertaking a research project a company should ask itself two questions: 1) Is the state of knowledge in the particular field sufficiently developed to give the project promise of success; 2) If results are obtained does it seem likely that they can be profitably commercialized."— W. F. Rockwell, Jr., president, Rockwell Mfg. Co.

Quality Control Begins with Logging[1]

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Quality control in log making consists in classifying and grading logs in accordance with the products to which they are best suited. Such control, properly practiced, can result in upgrading log values. Controlled log cutting, with resulting benefits, can be applied to most timber now being cut.

QUALITY CONTROL as applied to products manufactured from a log means obtaining the highest possible value from every log cut. Therefore, quality control, as applied to logging, means making logs designed to yield the products to which they are best suited, thus providing in advance for obtaining the highest possible value from every log. This procedure will apply to trees and to the timber tracts producing the trees. Then quality control becomes, then, a matter of selection.

For purposes of this discussion, we shall assume a log as any round piece of timber, whether hard or soft wood, measuring from eight inches and up in diameter and from eight feet and up in length. Our consideration of quality control as applied to logging will also be confined only to the first phase of the logging job, namely timber cutting. This step includes the felling of the tree from the stump, limbing it, and, most important, bucking it into logs fitting the specifications of products for which it is most suitable.

Products Govern Quality Control in Logging

The wide range of products extracted from logs should be clearly defined and borne in mind. This conception of products applies whether we think in terms of hardwoods or softwoods. In the case of hardwoods, these products may be high-grade or furniture veneers, medium grade or panel veneers, low-grade or package veneers, factory lumber, utility and construction boards, cross ties, switch ties, and structural and dimension lumber and timbers. With the softwoods, the range is not quite as broad and includes yard lumber, structural lumber, factory and shop lumber, and cross ties. The yard lumber includes all of the sizes, patterns and grades required for ordinary construction and general purpose uses. The structural lumber is two inches or over in thickness and four inches or over in width, and is intended for use where working stresses are required. Its quality and grading are based on the strength of the piece and the use of the entire piece without further cutting. Factory and shop lumber is intended to be cut up for use in further manufacture, the same thing being true for hardwood factory lumber. Its quality and grading is based on the percentage of the area which will break down into a limited number of cuttings of a specified minimum size and quality.

There is a great need for an understanding of all of the factors affecting timber quality. This need is further emphasized by the general decreases in the average level and increase in the variability of timber quality within timber stands. With the almost complete disappearance of old growth timber and its replacement by the presently available stands of second-growth timber, high quality trees are rare. In general, volume per acre is low and the trees are small. Tree and log size are important to quality considerations because the factors that generally reduce quality are much more severe in small trees and logs than in large ones. For example, two 2-inch knots spaced five feet apart and 5 feet from each end on any one face of two 16-foot hardwood logs, one of which has a scaling diameter of 21 inches and the other 11 inches, will affect the smaller log more severely. After a 6-inch face on the large log is reached, the log will yield a full board of FAS grade, subject of course to cross-cutting into clear face pieces; while in widths wider than 6 inches, ripping will produce a full length piece of FAS lumber and a common grade board with the knots included. However, all boards from the smaller log must remain full width and will make only common grade because the possible clear rip cuttings on each side of the knots will be too narrow to make the higher grades.

There are two major factors controlling the determination of the quality of products from any given log, whether they are pdoduced by sawing or veneering. The first governs the so-called higher grades of either class of material, and certainly the higher valued portion of it, and the utility is based on beauty and appearasce. The second is measured by the ability of the piece to perform the task of carrying a load in various manners, and its utility is based on strength rather than appearance. From this it can readily be seen that a blemish which might destroy the quality and utility of a piece of lumber for fine furniture would not affect its utility and quality for use as a structural member.

In stands of such variable quality, log making that is not guided by intelligent understanding of the factors affecting the quality of the product to be cut from the log will result in material loss. The too-often used method of applying a given length of measuring pole continuously from the butt to the merchantable top of a felled tree can result in startling losses in the quality and value of products cut from the logs from this same tree. The financial success of an operation also depends upon the lower limits or floor of merchantability for logs and for the trees from which they come. This determination can be made only by the application of quality measures or grading rules.

With the general decrease in quality of our timber stands, it is becoming more necessary to prepare for several markets rather than to cut for a single use, if the most profitable operation of the woods is to be attained. From a given tract, logging operations might produce all grades of veneer logs, all grades of factory lumber logs, tie and structural lumber and timber logs, stave bolts, dimension bolts, fence posts, pulpwood, chemical wood, and even fuel wood. More understanding of timber quality is essential to the successful accomplishment of such multi-product logging operations. It is a fact that the time is fast approaching when supplies of standing timber and the resulting logs available for such high-grade uses as furniture grade veneers, large dimension oak structural timbers for shipbuilding, and others of a like nature, will reach a point where there simply will not be enough of such material to fill all of the demands

[1] Presented at meeting of the Forest Products Research Society, Deep South Section, November 8, 1952, Baton Rouge, Louisiana.

under present methods of operation. Recent application of existing sawlog grades for board production to hardwood timber stands in several sections of the eastern half of the country points up that, from 40 to 65 percent of the logs in these stands were in the No. 3 log grade. In one of our best hardwood areas, only 25 percent were No. 1 log grade. This means that, without exchange of timber and/or logs between operations making different products, some of the markets presently supplied by wood will be lost to materials other than wood.

Present Status of Log Quality Measures or Grades and Their Use

The exercise of quality control consists in applying measures of quality based on the product. These measures are termed grades. More work has been done in the field of hardwood log grades and yield studies to support them than for softwoods. In January, 1947, a report "Interim Sawlog Grades for Southern Hardwoods" was published by a Forest Service Committee set up for this purpose. These included three grades based on predicting the yield of logs in terms of factory lumber grades as published by the National Hardwood Lumber Association. These grades held until March 1949, when the Forest Products Laboratory, after many years of research in hardwood sawlog quality conducted at hardwood sawmills scattered over the southern and eastern portions of the country, published "Log Grades for Standard Lumber." Again the grades were based on the yields in terms of the N.H.L.A. lumber grading rules and the publication included yield tables by species, log grade, and diameter class, for most of the important hardwood species. At the same time the Southern Forest Experiment Station came out with a mimeograph entitled "Material for Hardwood Log Grading Course." This publication included, in addition to the Forest Products Laboratory grades, interim grades and specifications for two other classes of logs, namely, tie and timber logs and local use logs. The products of this last class never get into the general marketing channels but are handled on a strictly local basis—mostly as low grade construction boards.

At this time the Texas Forest Service, through its laboratory at Lufkin, initiated a study for the determination of yields of these low-grade logs, that is, Forest Products Laboratory Log Grade 3 and poorer in terms of N.H.L.A. graded lumber. Results of this study have also been published. Purdue University, through its Forestry Department, has also carried on extensive studies in hardwood sawlog grades and publications are available on these. In 1948, the Tennessee Valley Authority initiated an extensive study in log grades and grade yields conducted at some sixty mills scattered throughout the Valley. The Forest Products Laboratory log grades for factory lumber logs plus the interim tie and timber log grades and local use log grade of the Southern Forest Experiment Station were tested in this study. Publications giving the results of this study in terms of several thousands of hardwood logs are also available. The Southeastern Forest Experiment Station at Asheville, N. C. has also published the results from log grade and yield studies. Local log grades of a rough character are in use at many operations throughout the hardwood regions.

This brings us to another important consideration, namely, that in applying quality control to logging, it is necessary to establish a system of log classes based on separate product classes, and then to apply log grades within these classes. As the major portion of hardwood log grade research work has so far been concerned with the factory lumber log class, there is still research needed for veneer, tie and timber, and local use class logs. Thus far, there are no recognized hardwood veneer class log grades and only interim grades for tie and timber and local use class logs.

In the field of softwood log grades, there have been several widely scattered projects but, so far, no recognized standard log grades are available. Log grades for southern yellow pine were evolved several years ago at the Crossett Experimental Forest and have been used there and at other Forest Service Research Centers throughout the South. Recently, a Committee of representatives from the Southeastern and Southern Forest Experiment Stations and the Region 8 Office of the U. S. Forest Service has been working on pine log and tree grades. A report on this work has been submitted to the Chief's Office of the Forest Service with recommendations that these log grades be accepted as Forest Service standards. From a rather intimate knowledge of the grades, it is the belief of this author that they are the best yet evolved and they are based on two substantial yield studies conducted by the Southeastern Forest Experiment Station. Additional yield studies at other points throughout the southern pine region are felt to be necessary before submitting these grades for universal acceptance and application. All studies and grades in the softwood field so far have been based on board class logs. Additional work is needed on structural and timber class logs. In considering this last class, adjustment for wood density will have to be incorporated into the studies. Again, a few companies apply rough log grades of their own to the purchase of logs at their mills. Some years ago, there was published a set of log grades for southern pine by the Southern Pine Association, but these were never very widely adopted.

This brings us now to a consideration of the present use of log grades in attempting to attain to quality control. Here again the major emphasis has been on hardwood grades. During four years as a member of the Forest Utilization Service at the Southern Forest Experiment Station, it was the privilege of this author to conduct 20 hardwod log grading schools during which between 400 and 500 individuals were trained in the application of hardwood log classes and grades. In addition, several similar schools have been conducted in the Northeast and Middle West by members of the staff of the Northeastern Forest Experiment Station. All of the schools participated in by the author were located in the southern States. Individuals so trained included forest school students, industrial foresters, forest school teachers, extension foresters, U. S. Forest Service personnel, State Forest Service personnel from nearly all of the southern States, and a few miscellaneous individuals. It was most gratifying to note that, by far the greatest number of individuals trained came from industry, and this class of trainees accounted for nearly 25 percent of the total number trained. To this author's knowledge, there are now four forestry schools including hardwood log classification and grading instruction in their forest management, mensuration, and utilization courses—all four of these are located in the South.

An outstanding example of the application of quality control was supplied by one large southern operator who, in 1949, on a production of four million feet of gum lumber, enjoyed a yield of only 57 percent of No. 2 common and better grade lumber. In 1950, after initiating quality control in logging, the same operator on approximately the same production cut from similar trees enjoyed a yield of 71 percent No. 2 common and better grade lumber—and the increase of 14 percent on yields of higher grades was not all confined to No. 2 common either. How was this accomplished? The company forester attended a hardwood log grading school and, upon

his return, held a similar school for all other foresters, timber markers, and scalers in the organization. In the timber marking program following this school, the marker graded the logs in each hardwood tree, cleaned a place on the bark, and with a paint stick marked at the bottom of this space stump height; above this a line, the length of the butt log, and then lines and additional log lengths up to the merchantable top limit of the tree. It was then the scaler's responsibility to see that this cutting scheme was followed when the timber was cut.

Another large operator has also trained all personnel concerned in log grading. Each week an analysis of the graded lumber and product tallies is made and, on the next Monday morning, instructions are issued as to the lower limit to which to go in log class and grade in bringing in hardwood logs to the mill for the current week. These are but two of the many instances of the use and application of the hardwood log classes and grades being made in the interests of quality control.

It has always been a mystery why many operators, and some of them with very large capital investments in manufacturing plants and timberlands, should allow their raw material to be butchered up by ordinary timber cutters working without control or supervision. This practice is still continuing in many instances, although stumpage prices have risen to a point where whatever profit there is has to be made from the manufactured products. In the past, of course, much profit was made from the purchase of cheap timber and thus it was not so necessary that a substantial margin for profit come from the operation of the manufacturing plant.

Within recent months, the author checked some large white oak logs cut from some very high-priced stumpage in the State of Alabama. These logs had been cut 16 feet long in almost all cases. Upon checking through the mill, the board value of several of these logs had been reduced from $128 per thousand to $86 per thousand because of the inclusion of log defects which reduced the grade yield in terms of boards. The possible gross board value of $128 per thousand could have been realized by the application of quality control measures during or previous to the cutting. This would have resulted in making some of the logs into 12 and 14-foot lengths. Such practice is not always in the direction of shorter logs. One instance of this was observed where several butt logs had been cut 14 feet long and graded as No. 2 logs by the Forest Products Laboratory log grades. All of these logs would have graded as No. 1 if they had been cut 16 feet long and the grade of the second logs would not have been changed.

Conclusion

The following recommendations are offered for attaining quality control in logging and thus increasing the value of products manufactured from the logs:

1. Obtain all available information on the existing log classes and grades.
2. Promote the initiation of studies which will yield log grades for classes of logs where they do not now exist.
3. Train all personnel connected with the timber cutting operation in the application of log grades.
4. Apply additional and intensive supervision to the log cutting operation. It takes but a few dollars increase in value on a few thousand board feet of logs to pay several times the necessary investment.
5. On a given logging operation classify, grade, and designate logs so that they will be cut into the products for which they are best suited, thus enabling them to produce the highest quality yield and value. This may result in selling logs to or exchanging them with other operators who manufacture different products.

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100 Years Engineering Progress with Wood

Timber Engineering Company, Washington, D. C., has sponsored publication of the papers presented at the Wood Symposium, held last fall in Chicago to celebrate "100 Years of Engineered Progress with Wood," as a service to the entire wood industry.

The papers, taken together, do a masterful job of outlining, frequently in detail and always with an understanding of wood's important place in the American economy, the tremendous improvements that have been made toward putting wood in the category of a precisely engineered product.

Representatives of various phases of private industry, associations, and private and public laboratories combined in the symposium to cover every major phase of wood progress. Beyond this, the speakers, in addition to reviewing the past, looked to future accomplishments that will give wood wider fields of application and extend our forest supplies into the indefinite future.

Speaking on "The Role of Wood in Industry," Clark C. Heritage, Weyerhaeuser Timber Company, Tacoma, Washington, listed three major fields of future endeavor of vital interest to the lumber industry and the engineering profession: 1) the supply of forest raw material, 2) integrating the performance of producers and consumers, and 3) achieving greater product variety of increased utility with more perfect utilization.

The volume includes papers summarizing progress made in all major structural uses of wood, the development of new wood products and the improvements in woodworking tools and equipment that have helped make these advancements possible, as well as papers covering progress made in such fundamental fields as improved grading for use and in engineered design.

In a word, the volume comprises an expert summation of the status of wood today and its widespread importance to the American economy. Numerous illustrations help picture the changes that have taken place.

"The sole purpose of bringing the 21 papers included together in one volume," according to Harry G. Uhl, president of Timber Engineering Company, "is to make available to the engineering and architectural professions, and to industry executives, a permanent record of the valuable historical and current data presented by recognized authorities on wood as an engineering and industrial material."

Single copies are available free of charge to FPRS members and others on request to Timber Engineering Company, Dept. WS–L, 1319 18th Street N. W., Washington 6, D. C.

Take the "Hand" Out of Lumber Handling[1]

T. J. GILBERT and JACK McDONNOUGH

Secretary and Lumber Handling Engineer respectively, Moore Dry Kiln Company, Jacksonville, Florida

Modern handling equipment is designed to cut labor costs and speed up the flow of lumber through a plant. It also helps improve quality of product. Its efficiency is improved through proper location in relation to other plant operations. Although standardized, today's equipment is flexible enough to meet diverse handling problems.

SLOW HAND-POWER is fast giving way to new improvements in the southern and eastern lumber and wookworking industries. Much development has taken place. Today there are many ways available for cost reduction. Lumber handling cost *Can* be reduced by using mechanical equipment now available. This equipment of advanced design is suitable for both new and existing mills.

History and Development

West Coast Developments and Reasons: The west coast mills first adopted in large numbers the use of mechanical handling equipment. Mechanical handling became a "must" with them years ago because of the size of the logs handled, the daily output of their mills, the high labor cost and the need for mass production at lowest cost to compete with mills much nearer the major lumber markets. Their mechanizing the handling of lumber from the sawmill, through the kilns and into the planing mills deserves a great deal of credit for reducing cost. It is this portion of the overall mills' operation which receives attention in this article—from sawmill into planing mill. From observation of southern and eastern mills in general there is greater opportunity for larger cost reductions in improved lumber handling than in any other section of their plant.

It has been said that west coast mills are willing to spend as much as $10,000.00 for each man eliminated from a productive operation. In the south and east this figure may be lower, but whatever any particular mill can afford to spend will have to be determined by their own economics of dollars invested related to benefits received. A study of each mill's particular operations is required. Much equipment has been installed in the south and east during the recent years and many mills have found that the savings gained paid for the complete installation in two years, and often, less. Where else can quicker returns on an investment be realized.

Sellers Market Prevented Realizing Actual Needs: Many mills have operated successfully during the sellers market of recent years. However, faced with the increasing buyers market, these same mills find their profits disappearing; they know they must do something—but what? These mills can take a page out of the west coast mills' book of prior experience and employ similar cost saving methods—but similar only in method, since duplicate of equipment designed for west coast conditions will not always be best suited for eastern and southern mills.

East and South Different—More Variables: The south and east is unlike that of west. The lumber being handled is different, it comes from smaller, shorter logs resulting in more narrower and shorter boards. Most mills are operating on second growth trees.

Times have changed in the east and south. Labor costs have risen sharply. The virgin timber lands are all but cut out. The mills must run on second growth trees, resulting in the handling of many more individual pieces of lumber for each 1000 board feet produced.

Mills in the east and south are smaller. The logs are smaller, shorter and not as straight. The resulting boards cut are narrower and shorter. The trees often grow crooked and even when sawn straight, the internal stresses built up in the log during the trees growing life causes that board to twist or bow later. Such lumber is more difficult to handle mechanically than lumber with lesser number of these variables.

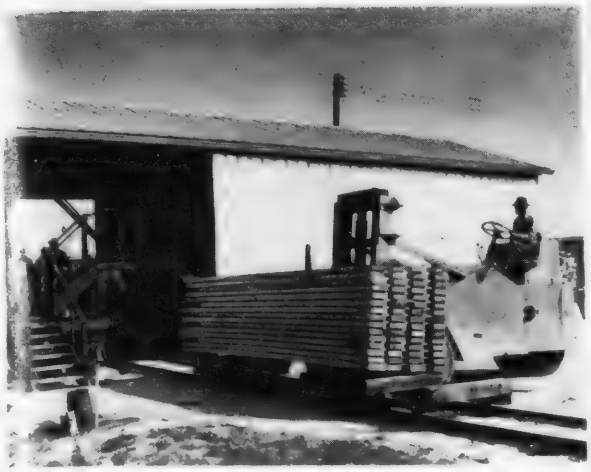
For these reasons it was necessary to develop lumber handling equipment specifically suited to the actual needs of the mills in the East and South. It is patterned in general after that developed for west coast use, but it took years of study and more of pilot model development to produce equipment for the eastern and southern mills.

Edge Sorter-Lumber Stacker Tie Together: One system is the use of edge sorters where boards are rolled out in slots on edge and moved on power driven rolls. Many edge sorters are equipped with automatic features for automatically sorting for length or width. Each of the accumulation bays are equipped with power floor chains and running the full length of all the bays is a live roll bed or belt conveyor. With this arrangement the lumber from any one bay can be run out by power means, and transported by power to the lumber stacker. This method entirely eliminates the hand handling of one board at a time and pulling it from horizontal type chain sorters into solid packages. From observation the maximum cost savings are gained where this system can be used, but many mills due to their operating conditions cannot use it. However, they can use other systems and get large cost savings.

Unit Package-Lumber Stacker Tie Together for Flexibility: The unit package handling systems came about with the advent of the straddle and fork truck development. They give a great deal of flexibility to a mill's operating set-up. At many mills the straddle or fork truck was the connecting link for tying together a horizontal green sorter where the boards are pulled into solid unit packages and a mechanical lumber stacker. With a power means of transporting lumber in packages from a sorter the mills could install a mechanical lumber stacker and cut their stacking cost in many cases by more than one-half.

Other Systems Also Available: There are many other arrangements for stacking kiln loads or stickered unit packages for new mills or for old mills, for pine or hardwood mills, or mills cutting both pine and hardwoods. The use of fork and straddle trucks gives a great amount of flexibility of layouts and arrangements that can be worked out to fit

[1] Presented at meeting of Forest Products Research Society, Carolinas-Chesapeake Section, November 7, 1952.



Close-up of fork truck picking up stickered package which was automatically discharged from stacker onto rails seen in foreground. Trucks and bunks are bolted together—never leave rails.

Rack-Off Type Unstacker—stickers and welded truck and bunk units are returned to stacker in background without further handling.

most of the existing mills. Even though the present mills have "just grown" through the years, they can take advantage now of many of the possible cost savings.

Trend Toward Six Foot Wide Packages and Six Foot Wide Kiln Loads: This modern handling equipment makes it possible to stack only for kiln drying or stack for yard drying, then subsequent kiln drying, or yard drying only. This means the lumber need be stacked on stickers only once. For those mills that do yard drying this means eliminating the board by board stacking, and unstacking operation on the yard. This is a big cost saving. At many mills the trend has been toward six foot wide packages and six foot wide kiln loads as opposed to the previous eight food wide kiln loads and smaller dimension stickered packages. Triple track dry kilns using six foot wide loads are in operation drying three loads abreast in each kiln room. The triple track kilns have about one-eighth greater holding capacity than the usual double track kiln with eight foot wide loads. This means that the cost of kiln equipment and building remains relatively the same.

One might ask why go to six foot loads? One reason for this is that at mills where air drying is being done, a fork truck can be used for placing packages on the air drying yard, one on top of the other. An eight foot wide package with its loads centered farther out on the forks requires a heavier and sturdier roadways. They receive more punishment than fork trucks handling six foot wide loads and usually require more maintenance. Similar considerations apply to straddle trucks.

Another reason for six foot wide packages is that the kiln load can be made up of two or more stickered packages, one on top of the other. Proper sticker alignment cannot be always achieved the full width of a kiln load to get best drying conditions when the kiln load width is made of a multiple number of stickered packages.

Sticker Cost, A Most Overlooked Item: A very important factor is the cost of stacking stickers. Many mills through force of habit have overlooked this, and do not actually know just how high the cost of stacking sticks is. In some instances the cost of stacking sticks used was about equal to direct labor cost of stacking lumber.

The trend to the six foot wide loads is also encouraged by the cost of stacking sticks, because eight foot long lumber commands a much better price than does six foot long lumber. It is therefore cheaper to make stacking sticks out of six foot lumber. Some mills say they always make their stacking sticks out of so-called "scrap". However, with the greater utilization of lumber in byproducts it gains in importance to reduce sticker cost.

Stackers and unstackers permit longer sticker life and lower sticker cost. With this equipment Stickers are often returned to the stacker in hoppers or directly from the unstacker on power transfer chains.

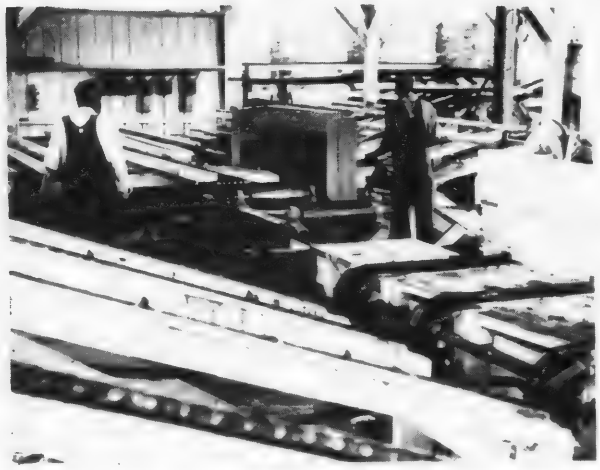
Lumber Handling Equipment Types and Functions

Lumber Stackers for Kiln Loads and Stickered Packages: Many types of mechanical stackers have been built during the past. The lumber industry now has available a complete line of mechanical lumber stackers to fit almost any size or type mill of most any capacity, large or small and to fit varying layouts and arrangements. Lumber stackers now being used fall into five general types, as follows:

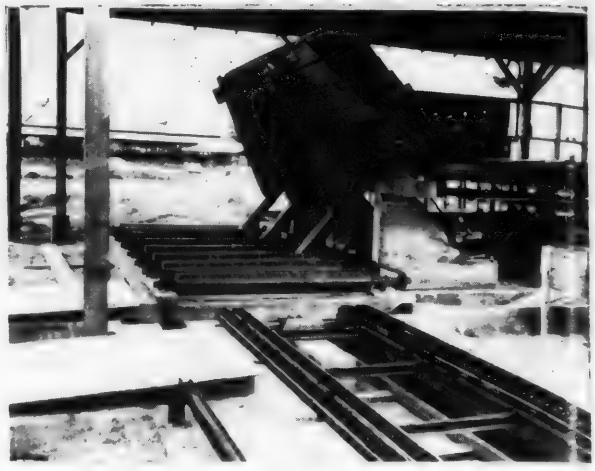
1. Ducking dog type with or without automatic sticker placer. Used mostly on the West Coast for large capacity mills.
2. Roller types stacker designed specifically for medium or large eastern and southern mills.
3. Pusher type stacker—this is a medium capacity machine at lower cost.
4. Hoist type stacker—this is a medium capacity machine where space requirements are limited.
5. Lift type stacker—a low capacity machine for the smaller mills.

Roller Type and Pusher Type Stacker: The development of roller type stacker was an outgrowth of the pusher type stacker. First installed was the pusher type which involved a cable lumber lift with sticker guides, a tilting type breakdown hoist and a 20 foot long pusher stacker mechanism. With the pusher type stacker the weight of the lumber on the chains creates pressure enough to push boards on to the loads being stacked. One of the workmen breaks the course, the cable lift is dropped a distance equal to the course thickness plus the sticker thickness and then the next set of stickers are placed by hand.

The pusher type stacker is used with either kiln loads or packages.



Electric Swede pulling lumber from sorter for remanufacturing.



Lift Unstacker feeding two cut-off saws in furniture plant.

On one job a pusher type stacker, with a five man crew stacked the same quantity of lumber formerly requiring 14 men. This customer reported that even if he had made no direct saving in stacking cost, this stacker installation would have still been a good paying investment. He found that because of mechanical stacking the loads were more uniform in size and vertical sticker alignment was almost perfect which enabled his lumber to dry flatter and more uniformly. These indirect advantages permitted faster machining; a greater utilization of lumber and fewer time consuming jams and slow downs through his machines.

The roller type of stacker was developed later and employs the use of a course measuring mechanism and various automatic features permitting a higher rate of stacking with crew of only five men than could be previously obtained with the pusher type of stacker. With this stacker, one man operates the tilting breakdown hoist, breaking down the solid packages of lumber and making up the courses. There are two men placing stickers, one of whom pushes a foot button starting the automatic stacking cycle whereby a course of lumber is pushed on to the load, the lift drops automatically the proper amount and the course stacking unit stops itself automatically ready to begin its next cycle. Then the stickers are placed by hand and the operation repeated until a load is completely stacked. The lift can be equipped with means for rapidly discharging the completed load either by gravity or by power thus quickly readying the stacker for stacking the next load. These stackers may be installed at an elevated level or near ground level, whichever conforms best with local conditions. They may be used for cross piling as well as end-piling loads, for kiln loads as well as packages.

These stackers can be served by fork trucks or straddle trucks with the packages moving to the tilting breakdown hoist either sidewise or endwise. Solid packages may also be brought to the tilting type breakdown hoist running on rails although it must be recognized that this retards the operation somewhat.

One large southern sawmill using a roller type, kiln load stacker with a 3 man crew has been averaging better than 9,500 Bd. Ft. per hour of 4/4 lumber. This means for each man-hour of direct labor approximately 3200 Bd. Ft. of lumber are stacked. Stating this another way, they are stacking at an average rate of two eight feet wide courses per minute or a 60 course load each 30 minutes, or two kiln loads per hour, using only three men. These are average figures over a full month's operation.

An eastern manufacturer with a roller type kiln stacker has found it a good paying investment although he requires only a few loads stacked each day. The principal reasons for this are they stack very thick, heavy stock in the long lengths and also to maintain highest quality drying through near perfect sticker alignment as well as vertical sides on the load.

Hoist Type Stacker: The hoist type of stacker is similar to the pusher type except the tilting type breakdown hoist is installed very close to the stacking lift and a short transfer section between. For mills handling 30,000 to 60,000 Bd. Ft. per eight hour day, and where space requirements are limited a stacker of this type with a crew of two to four men will fit very nicely.

Lift Stacker: For smaller mills stacking 15,000 to 30,000 Bd. Ft. day, the lift stacker is a good paying investment. This consists of a cable lift and a stacker guide unit. Two men is normally a crew. The lift maintains a fixed stacking level and the sticker guides provide good vertical sticker alignment as well as good vertical sides to the kiln loads.

Package Stackers: Package stackers have been gaining favor, both for air drying and kiln drying; for Hardwoods and Softwoods. Package stackers are similar to kiln load stackers except they stack narrower courses and the package loads are shorter in height. A North Carolina lumber concern has stacked close to 100,000 Bd. Ft. in 4′ x 4′ packages in 9½ hours using a crew of only five men. Another roller type package stacker is regularly stacking about 65 packages per day, 6′ wide x 4′ high of green, random length Hardwoods with the boards spaced apart for air drying.

Stacking Cost Possibilities: Some plants where these mechanical stackers of advanced design are installed have reported direct stacking cost ranging from 35¢ to 55¢ per 1000 Bd. Ft.

A Yardstick for Comparing Stacking Costs: In studying stacking costs at various mills, it has been convenient to use a common unit of measure, "Man-hours per 1,000 Bd. Ft." of lumber stacked. This figure is a yardstick that can be used for comparison from mill to mill, section to section, and does not vary with local wage rates. For any individual mill, you can figure stacking cost in terms of man-hours per 1,000 Bd. Ft

Tilting-Type Breakdown Hoist feeding onto stacker a package which was accumulated at green sorter. Conveyor chains in foreground handle solid packages brought in by fork or straddle trucks.

Roller-Type Kiln Load Stacker, showing solid package in center background moving to tilting hoist endwise, package on hoist being broken down, course being made up while another course is moving onto load, fully stickered load at left, and sticker return chains in foreground. Three man crew is required.

stacked and can readily convert this into dollars and cents by multiplying it by the average wage rate paid. Figuring on a per 1,000 Bd. Ft. basis also makes sense since a mill's products are priced on this basis.

Moving Loads After Being Stacked (Power Transfer Cars): Kiln loads are pulled away from the stacker by a cable car puller unit mounted on a power driven transfer car. The load can be discharged from the car by this same cable power means. This same power transfer car is used for charging and unloading the kilns. A power driven transfer car with one operator and sometimes a helper can move many kiln loads during a day's time; handling this work rapidly and at a very low cost.

There are many types of power transfer cars suitable for small or large mills, both gasoline and electric powered; slow speed and high speed; light tonnage and heavy tonnage cars. While the design has been standardized they can be made to suit most any present mill's track layout, as well as for end piling and cross piling loads.

Lumber Unstackers: For kiln loads there are several types of unstackers available depending capacity required and other mill conditions.

Lift Unstacker: For smaller mills the lift unstacker is often used, where one or two men manually pushes a course of boards off on to the sorting chains using a push pole. After each course is pushed off the stacking sticks are picked up and this cycle repeated. The cable lift is raised, step by step, to maintain a fixed level at the top of the load.

The cable lift is also used for machine feeding where kiln loads are unstacked at the same time fed into the machines. This is a common application for feeding lumber to rip saws, cut-off saws, etc.

Tilting Type Kiln Load Unstacker: A high capacity machine is the tilting type of kiln load unstacker. This machine operates like a tilting type breakdown hoist, tilting the entire kiln load, the operator then jogging the load up one course at a time, as required, by pushing a foot button. The stickers fall out automatically, by gravity, on to a sticker removal belt or a power means carrying them back to the stacker into hoppers, for transporting back to the stacking location. This machine is smooth and fast in operation and at the smaller capacity mills it could possibly be operated by the grader himself working on the sorting chains.

Rake-Off Type Unstacker: Another kiln load unstacker is the rake-off type. Power driven rake-off chains are used for pulling one course of lumber off at a time. The single operator has only to keep an eye on the operation and remove the ticks after each course is raked off.

Tilting Type Breakdown Hoist: The tilting type breakdown hoist is used for handling stickered and solid packages. It is used for feeding lumber to mechanical stackers, feeding lumber to planers, trimmers, other wood working machines and sorting chains. Many are used for breaking down solid packages of lumber and feeding green sorters. This flexible machine has many other applications, wherever a solid or stickered package of lumber is to be broken down and fed into its next operation.

A tilting type breakdown hoist accomplishes the unstacking operation where lumber is handled in stickered packages. The stickers automatically fall off by gravity on to a sticker removal belt.

At a southern mill that had installed their first tilting hoist advised they were able to save 9 men in the handling of stickers and straddle truck bunks alone through the use of a tilting hoist feeding his planer. In this case, with this machine they were unstacking stickened packages. At another mill, one of the "old timers", who has operated planers for years, said that their breakdown hoist was "the only way" to feed a planer. He said they had greatly increased their production and at the end of the day, the operator was far less fatigued and they could give their customers better service.

Loader Hoist Accumulates Package: The modification of a breakdown hoist is the loader hoist. It is often used in planer mills to accumulate solid packages of surfaced lumber off the end of sorting chains. This machine requires only one man and he can handle many times more lumber than any other man along the sorting chain. Handles the high production item off of the sorting chains. For discharging the loader hoist drops down level and discharges the package for transporting away to the next operation by a straddle or fork truck.

Electric Swede: Used for remanufacturing circles from sorters. This machine for automatically pulls boards from a sorting chain rapidly and with a minimum of work by a man. The grader merely draws a board toward him a short distance and the electric swede automatically pulls it from the chain discharging it onto other chains, live rolls or whatever the particular case may require.

Equipment Liked by Men in Mill: Mechanical lumber handling equipment has had eager acceptance by the men operating it. Some at first believed these machines would work them harder, but later changed when they found the equipment eliminated much of the manual labor. Even though they were handling lumber at a much faster rate per hour they were much less fatigued.

One straddle truck operator admitted at first he was sure those power floor chains feeding hoist would work him quite hard, but later he found the results different. He delivered two or three packages to the chains then found that he actually had more spare time for other work. The hoist operator says they always have a good supply on hand for feeding the planer, whereas before when feeding by hand they would run out and have to wait many times on straddle truck operator to start running again.

Handling Equipment Helps Improve Quality: Installation of mechanical stacking and unstacking equipment is a step in improving quality. The stacking, drying and unstacking processes are interrelated. One cannot be considered without the other. A study of any situation should include drying as well as stacking and unstacking.

Equipment Design Standardized Yet Flexible: Design of lumber handling equipment has been standardized. Sufficient flexibility has been incorporated into these designs so as to allow the equipment to be manufactured to fit most individual plant requirements and fit both new mill layouts as well as layouts of many existing mills. Equipment in most cases is shipped in preassembled knocked down units. Most stackers are now furnished with prefabricated steel frameworks so installation can be made much more quickly and at lower cost at the mill site. The program of standardizing the design has resulted in a line of equipment suitable for most any size mill and at lower prices.

The Ideal Layout: Handling equipment cannot do the most efficient job unless properly located in relation to other operations at the plant. An ideal layout should provide for the following: 1. Lumber sources—single or multiple with only minimum number of separations necessary for drying; 2. Temporary storage ahead of stacker; 3. Lumber stacker; 4. Temporary storage stacked loads; 5. Power transportation means for green loads; 6. Storage at green end of kiln; 7. Dry Kilns (or yard drying); 8. Temporary storage of dried loads; 9. Power means for moving dry loads; 10. Truck and bunk return; 11. Sticker return.

It is not always possible to obtain the ideal layout, but it should be used as a guide toward that goal. The various advantages of such a layout should be kept in mind on any specific case and these advantages obtained as closely as possible depending upon the restrictions of any particular existing plant layout or mill. Many present day mills can get most of the advantages of this ideal layout.

Many mills by studying their lumber flow can find applications for this equipment and reduce their costs. All factors in the mill should be considered and an overall or master plan at least settled generally before proceeding. Settling an overall plan, at least generally, does not means that all of the equipment need be installed at once, but it should be considered before beginning the program so that eventually, step by step, all of the savings and the full benefits can be realized. There are engineering firms now active in assisting mills with plant layout and mill design problems. Some mills will find it to their advantage to use these services. The lumber industry in the south and east is using more engineering studies at their mills. This is a healthy condition as experienced sound mill engineering will benefit the industry in future years.

The Handling of Wood Fuel[1] [2]

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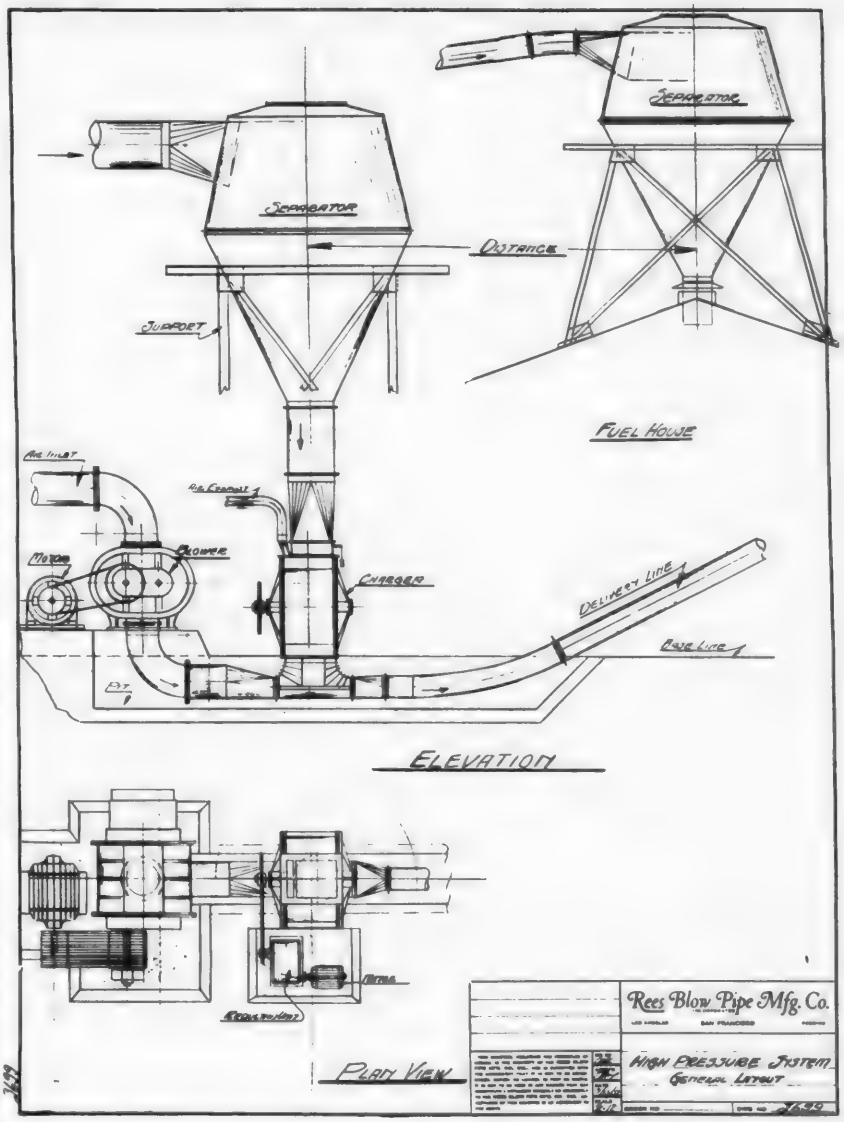
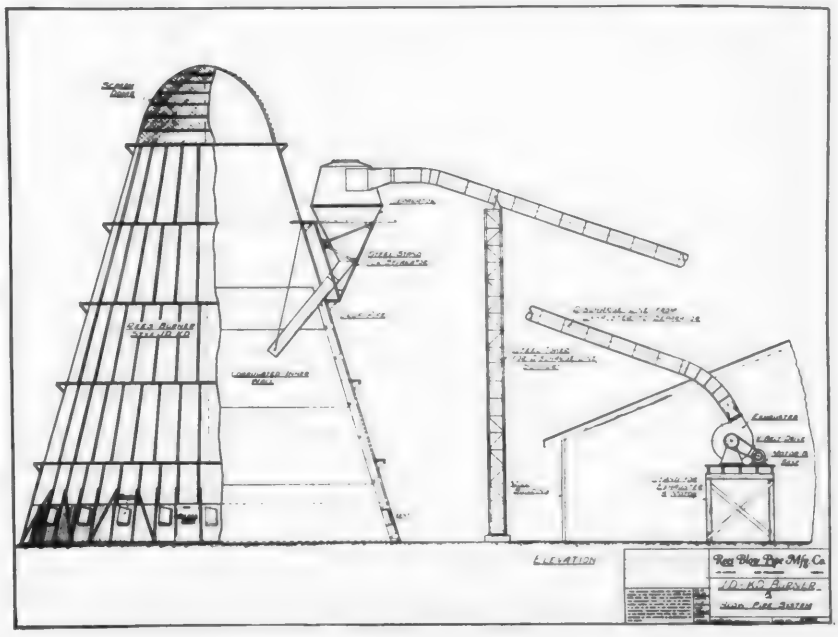
This subject is limited to the pneumatic handling of small-size particle dry wood waste with a blow-pipe system from all types of wood working machines and from special equipment such as hogs and hammer mills. The basic data necessary for design are the *peak* production per hour and the transport distance. Two types of blow pipe systems are used, the low-pressure or "vacuum" system and the high-pressure system. The low pressure system consists of an exhauster or fan that draws or sucks the waste away from the machines and discharges it on the pressure side to a pipe terminating in a separator or cyclone where the wood particles drop to the bottom and the dust-free air passes out at the top. This system should be designed so as to create the least resistance possible to air passage. It is best for distances not exceeding 500 feet but sometimes may transport materials up to 1000 feet. For greater distances a high-pressure system must be combined with the low-pressure system. This consists of a positive displacement blower and charger that receives the fuel from the discharge side of the exhauster and deposits it in the high-pressure delivery line where it is conveyed to fuel bin or burner. Such a delivery line can convey fuel for great distances; for example, the McCloud River Lumber Company conveys fuel 4,950 feet in one blow. The laden air has a velocity of about 7000 feet per minute in this 13 inch diameter pipe. The accompanying sketches illustrate both types of blow-pipe systems.





[1] Presented at meeting of the Forest Products Research Society, Northern California Section, October 31, 1952, at Sacramento, Calif.

[2] Summarized here by Robert A. Cockrell, University of California, Berkeley.

Chemical Utilization of Wood[1]

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Although chemical utilization of wood on a commercial basis requires a relatively large capital investment, the field has well defined advantages. Also, the future looks bright, with new products in the development stage. However, there is definite need for enlarged research programs, since many potential products are not now commercially feasible.

THERE ARE MANY REASONS why the Tennessee Valley Authority has long been interested in the forest developmental possibilities presented by the chemical utilization of wood. Chemical utilization has many advantages when considered as a means for achieving the improvement of the forest economy. The resource is generally over cut in its sawtimber stands, lacks markets for younger growth and low-grade material which should be removed in thinnings and improvement cuttings, and so far the full growth potentialities of the forest are yet to be realized.

The advantages of chemical utilization generally revolve around five factors:

1) Trees of small size can be used in chemical conversion. There is no other way to use them except for fuel, fence posts, and a few other minor products. Thus, the full development of forest stands is restricted early in the life of the forest because markets for these sizes of trees are limited. The expansion of chemical uses should assist in overcoming this bottleneck.

2). Wood waste and cull trees can be utilized chemically. Generally, in the major group of sawmill industries, waste averages around two-thirds of the total amount of the tree. At present much of this is used as fuel. The possibilities of obtaining higher values from wood waste through chemical conversion have historically intrigued mankind.

3). The productivity per man hour is high in the chemical industry and thus chemical conversion adds more to the general economy of the area. For example, the 1947 Census of Manufactures[1] reports that the lumber industries, employing 388,000 workers, produced $425,000,000 added by manufacture. On the other hand, the pulp and paper industry, with almost the same number, 389,000 workers employed, produced $888,000,000 value added by manufacture, or more than double the man hour productivity of the lumber industries.

4). The high conversion rate is attractive. This means that for each dollar's worth of raw material used, more dollars of finished product are made. For instance, in the case of the physical conversion industries, a dollar's worth of raw material produces from two to three dollars' worth of finished products. In the case of southern pine logs made into two-by-four studs, the conversion rate is $2.05; in the case of #2 and #3 red oak logs made into flooring, the conversion rate is $3.00. The chemical industries greatly increase this conversion value. For instance, one dollar's worth of pulpwood converted into kraft liner board will produce $4.87 worth of product. If this pulpwood were made into hardboard, such as quarter-inch tempered Masonite, it would produce $13.57 worth of finished product. The highest conversion value, as might be expected, results from the production of acetate rayon yarn. In this case, gum pulpwood so converted results in a final product value of $39.94 for each dollar's worth of raw material.

5). The high investment necessary for chemical conversion is advantageous from the standpoint of forest production. High investments result in an interest in permanent operation. This, in turn, leads to a well-defined interest in sustained yield forest management. There is no need to dwell upon this advantage. It has been pointed out in practically every status of management survey[2,3] which has been made. The larger industries follow better management practices in their woods. They are seeking stability.

Perhaps the above advantages are the reasons why the growth of the chemical wood-utilization industries has been so rapid. In 1947 the total production by the physical fabricating industries listed in the Census of Manufactures[1] under *Lumber and Products* and *Furniture and Fixtures* resulted in $3,193 million in value added by manufacture. In that same year, the chemical industries produced approximately an equivalent amount from the *Paper and Allied Products, Gum and Wood Chemicals,* and *Synthetic Fiber* industries. (See Table 1.) An examination of these figures shows the size of the chemical industries greatly exceeds that of industries engaged in physical product manufacture. The 29,500 plants fabricating wood products added values of about $100,000 each through manufacture. On the other hand, the 4,200 wood-using chemical industries added $800,000 each through manufacture, indicating that the size averages eight times as large and that their investments are probably in proportion.

The opportunities for expansion are significant. In many areas, waste materials produced by the physical processing group of industries are hardly used. Most of the material is either sold for fuel or used in the plant to produce steam. In addition, there are tremendous volumes of timber in the forest which can be removed at a profit only if they can be utilized by the chemical industries. For instance, in the Tennessee Valley, the general clean-up of the forests needed to place them in the best position to grow sound volume of good quality and desirable species awaits the development of more chemical use. Of these fourteen million acres of forest[4] 600,000 acres are overstocked

Table 1—1947 CENSUS OF MANUFACTURES, VOL. 1. GENERAL SUMMARY U. S. DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS

FOREST PRODUCTS INDUSTRIES*

(Value added by manufacture)
(Millions of dollars)

Physically Fabricated Products	1947	1939
Lumber and Products (except furniture)	2,497	731
Furniture and Fixtures:		
Wooden house furniture	493	147
Wooden office furniture	27	7
Window and door screens	44	7
Brooms and brushes	87	29
Matches	31	11
Tobacco pipes	14	5
	3,193	937
Chemically Fabricated Products		
Paper and Allied Products	2,875	888
Gum and Wood Chemicals	63	21
Synthetic Fibers, 1947—448; 1939— 169 50% wood pulp	224	84
	3,162	993
Total	6,355	1,930

*Includes only industries which could be isolated.

[1] Presented at meeting of Forest Products Research Society, Carolinas-Chesapeake Section, November 7, 1952, Raleigh, N. C.

and need thinning. Ten percent of the volume is in cull trees. There is an additional three billion board feet of cull which is sound and chemically usable now contained in trees merchantable for other products. In addition to this, approximately 2,700,000 cords of waste are produced each year, about half of which is woods waste and half factory waste. Our recent surveys indicate that only approximately three million cords of this material is now utilized, mostly for fuelwood, and very little of it for chemical conversion. Probably 200,000 cords would cover the annual use for chemical conversion in this area. Thus, a re-cast of the above shows that a large potential resource is unused, as follows:

Type	Amount	Time for Removal	Annual Yield (cords)
Cull Trees	2,700 million bd. ft. or 5,400,000 cords	Ten years	540,000
Thinnings	600,000 acres or 2,700,000 cords	Five years	540,000
Sound Cull	6,000,000 cords	Ten years	600,000
Waste (yearly)	3,800,000 tons, d.w.		2,700,000
Total (Ave. ½ cord per acre per year over forest area)			4,380,000
Now used for fuel, steam, etc.			3,000,000
Indicated surplus			1,380,000

However, more than this is actually available, because if chemical plants are so located as to be able to use this material, conversion values obtained should be higher than those obtained through the production of steam or use of the wood for fuel. Consequently, it might be assumed that a large part of the three million cords now used could also be available for chemical conversion.

This is the problem which confronted the Tennessee Valley area and which probably confronts most of the hardwood regions in the eastern part of the United States. TVA sought both physical and chemical means for utilizing this material. At the Milwaukee meeting, I gave a short paper on "Laminated Lumber from Low Grade Hardwoods,"[5] which told about our efforts to utilize some of this low-grade material physically. Dr. Nathan Gilbert, on the other hand, in his paper on "Utilization of Wood by Hydrolysis with Dilute Sulfuric Acid,"[6] told what we were doing in the way of pilot plant studies on wood hydrolysis with sulfuric acid for the production of molasses. I do not plan to repeat this information here. However, in choosing hydrolysis as a project for study, we had several choices in the field of chemical utilization, each of which was analyzed as to its potentialities. These were as follows:

1. EXTRACTION: The processes of extraction are profitably applied mainly in the extraction of tannins, essential oils, and turpentine and rosin products. We ran some studies on the extraction of oak slabs for tannin production and, in connection therewith, incidentally, studies on the separation of wood and bark from chips made from both slabs and round wood. An effort was also made to develop a portable still for the production of essential oils such as pine leaf oils, cedarwood oil, etc., but the resulting equipment was too heavy to be easily portable.[7] Probably additional research in this field will indicate some utilization possibilities which can be improved or have been overlooked.

2. DESTRUCTIVE DISTILLATION: This industry has been disintegrating because the synthetic production of acetic acid and wood alcohol is cheaper. As a result, (although we have one such plant operating in the Tennessee Valley) the demand for charcoal is not satisfied. To supply the demand for wood charcoal, small kilns have been opening up in parts of the Cumberland Plateau. Past research in this field has been directed largely to processes useful in large plants. Considerable work has been done in developing some small portable charcoal units, but the economics of production and marketing problems still need considerable study. The changes which have taken place in this industry indicate the need for further investigation.

3. PULPING: The production of paper insulating board, hardboard, and textile fibers is the largest field of chemical utilization. It is well serviced with research, the industry devoting considerable funds to studies in this field. The Forest Products Laboratory and several of the southern colleges are carrying on extensive programs. Therefore we felt that anything TVA might do would be overlapping and duplicating research which might be done at existing institutions. TVA research in this field has thus been largely confined to studies of thinning methods, thinning economics and pulpwood production economics.

4. HYDROLYSIS: This process, through the percolation of wood chips with dilute sulfuric acid, removes a sugar solution which can be used as molasses when concentrated or, in dilute form, may be fermented into ethyl alcohol or used to produce yeast with a high protein content. Because of the large amount of factory waste in the Tennessee Valley and the need for supplemental livestock feeds resulting from the expansion of the livestock industry and the promotion of the pasture-livestock programs, this project was one on which TVA chose to cooperate with the Forest Products Laboratory. Reports on this work are now available. However, we found that although during eight of the last ten years molasses for livestock feed could have been produced economically, (the cost being around 20 to 24 cents per gallon) at the present time there is a serious depression in the price of blackstrap molasses and the process would not be economically competitive on today's market. The recovery of byproducts, such as furfural, may reduce the price of molasses to a competitive range. We plan studies on this phase this year.

We are now also considering the possibility of using a dry process which would utilize hydrogen fluoride gas to reduce the wood, producing a sugar of higher concentration and what we hope might be valuable byproducts to be obtained from the unaltered lignin component. The Forest Products Laboratory is now studying this process and if their results provide sufficient justification, TVA plans to conduct pilot plant investigations as soon as the preliminary tests have been completed. However, there are many problems which must first be worked out.

5. HYDROGENATION: This process has been studied in a preliminary way by the Forest Products Laboratory. It is essentially similar to petroleum cracking, using high pressures, 1,500 to 2,000 p.s.i., and high temperatures in an atmosphere of hydrogen in the presence of a metallic catalyst. The work so far carried out has been done with lignin and has resulted in products ranging from alcohols through phenolic compounds to complex neutral oils, some fractions of which are similar to lubricating oils and others very similar to gasoline. Pilot plant equipment for this type of research is very expensive, as would be a commercial size plant, and it is doubtful at this time that the alcohols, oils and phenolics produced could economically compete with the products of the petroleum industry. However, the fact that such products can be produced indicates that in the forest is a tremendous latent energy resource which can become the basic foundation of a chemical in-

dustry when coal and oil reserves run low and the prices of the products of these industries increase to the point where wood hydrogenation might become profitable. Meanwhile, this is an intriguing field of fundamental wood-utilization research.

6. BIOLOGICAL TREATMENTS: Finely subdivided wood in the form of wood flour can be directly inoculated with fungi and bacteria to produce products as variable as the scope of the various species and genera of fungi and bacteria which feed upon wood. This direct chemical conversion of wood through biological processes has had very little study. However, it gives promise of providing methods whereby a large variety of chemicals might be economically produced. Such investigations do not require extremely expensive equipment, can be carried out within reasonable time limits, and may result in the solution of some of our waste problems.

7. CHEMICAL ALTERATION: Although these processes are not strictly chemical, in that they do not change the chemical structure of the wood, they are designed to provide means whereby the characteristics of wood may be changed to make it more usable for certain purposes. These changes are made through the application of chemicals which make wood more resistant to decay, fireproof it, make it harder, or stabilize its dimensions, or in some other way affect its physical properties. Most of the investigations to date have dealt with preservation, improving fire resistance, and the manufacture of Impreg, Compreg and Staypak.

These fields of chemical utilization, which have been so sketchily described, involve thousands of products and research possibilities for the improvement of existing products, better processing methods designed to reduce the costs of production and the development of new products through new processes. The field is so large that any investigative agency desiring to conduct research in the field of chemical utilization must carefully assay projects chosen for consideration in the light of their economic potentialities. Although it is not entirely senseless to engage in research for its own sake, customarily investigations are undertaken for the purpose of determining facts which will improve the economic situation of a particular sector of the industry.

The chemical field offers tremendous promise. For instance, the report by the President's Materials Policy Commission, entitled "Resources for Freedom," estimates that the consumption of paper and paper board is expected to increase from 28.9 million tons in 1950 to 51.7 million tons in 1975. Similarly, in the textile fiber and plastics field, where 600,000 tons of wood were consumed in 1950, it is expected that two million tons will be consumed in 1975.

Such expansions demand expanded research. At the present time, it is estimated that private industry is expending seven to eight million dollars annually on forestry research, of which a portion is used for chemical utilization investigations. The American Forestry Association report on "The Progress of Forestry" points out that 45 percent of the projects in wood research are in the field of chemicals and chemical products. Total funds spent for forestry research, including federal and state, amounted to 17 million dollars in 1949. In my opinion, this is not an adequate research program for the industry. Some large corporations, as a matter of policy, consider that from one to three percent of their net return should be spent for the improvement of their products and development of new products. They have found such a policy economic and conducive to an expanding enterprise. If the chemical wood-using industries were to adopt a similar policy, even at the one percent level, they would expect to finance sixty million dollars of research annually. This probably is ten times the amount now expended.

On this basis, I believe we can expect that private industry, to satisfy its own interests, will in the future find it necessary to expand research in chemical utilization. This would be most fortunate for the forester who is interested in achieving optimum production from forest lands. Without the development of new products and processes which can utilize waste upon the factory and the woods, which can utilize thinnings and improvement cuttings, it would be difficult to arrive at full forest productivity. Fortunately, most of the chemical industry is founded on the use of round wood four inches or more in diameter. The harvest of these sizes from thinnings will be conducive to improved forest growth and should stimulate the production of sawlogs under good management practices. Much of the material of this size which should be removed consists of hardwoods and, more particularly, of dense hardwoods like oak and hickory. It is in this category that full utilization of small wood is needed. It is probably in this field that the main research effort in chemical utilization should be directed. The economic use of this large resource is a question which must be solved if foresters are to achieve optimum sustained yield management in this area.

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Hardwood Charcoal as a Forest Product For the Utilization of Low Grade Southern Hardwoods[1]

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Much present-day charcoal production is complementary to the operation of wood derivative chemical plants. One objective of the plant described is to use low grade hardwoods being cut to encourage pine reproduction.

CHARCOAL HAS BEEN produced for several thousand years. It could be considered one of mans earliest manufactured products. Each civilization in turn produced charcoal for domestic and industrial uses. The vast forests of the Orient and later the forests of Europe were consumed not only for lumber but also for the production of charcoal.

Charcoal production in the United States started before the Revolutionary War with the introduction of small iron blast furnaces in New England and Pennsylvania. As the iron industry increased the charcoal production followed the same pace. The introduction of coke in the blast furnaces replaced the charcoal. At the turn of the century there were still a number of isolated furnaces in the United States making charcoal iron.

As the chemical industries started to expand at the beginning of this century, there was a great demand for acetic acid, wood alcohol, and the various allied chemicals derived from distillation of wood. At first this industry was located in the hardwood forests of Pennsylvania, but as the wood was consumed the plants were spread out into the other hardwood areas. The present Tennessee Eastman Plant at Kingsport, Tennessee, was located there during the first World War because of the great availability of hardwood to supply the retorts. In these operations the charcoal is considered a by-product.

The advancement of chemistry in the petroleum industry soon made it possible to make these various chemicals synthetically at a price which was very competitive with distillation of wood. These synthetic processes were not only able to meet the price but to supply the increasing demand. Retort plants consider charcoal as important a product as the products of distillation. The largest single outlet for charcoal is in the production of sulphur disulfide. The estimated present production of charcoal is 300,000 short tons.

At the present time the production of charcoal seems to be ample for the present requirements but is checked by the United States Department of Commerce, Bureau of Census, for the National Production Authority. Certain of the specialized products such as granular charcoal are on an allocation basis.

In this paper we shall primarily consider production of charcoal from hardwoods of the Southeast. The principle constituents of wood are cellulose, lignin and water. Elements important in carbonization are carbon, oxygen and hydrogen. Charcoal is the result of a series of processes, drying, heating, exothermic decomposition, calcining or soaking, and cooling without access to air. The process is a combination of physical and chemical changes which must be controlled to arrive at the desired end products. Time required for this complete cycle varies with the process and the end products desired.

The various stages in the carbonization of wood are dependent upon the temperature. Wood heated to 300°F. first loses its water and dries without undergoing any chemical changes. From this point to 500°F. the wood turns brown and disintegration starts. The carbon of the cellulose and the lignin is partially transformed into carbon and partially volatilized into liquid and gaseous products. Above 500°F. the reaction is exothermic and the temperature rises rapidly to about 750 to 800 degrees F. This is the phase of complete carbonization and the range of heating for production of charcoal. The final phase is the cooling to reduce temperature below ignition point.

There are several methods of producing charcoal.

Pit or Mound Method

Cord wood is tightly stacked in cone shaped pile on a level, well drained location. Fifteen to twenty-five cords is an average charge. The wood is then covered with a layer of straw and a layer of earth to seal off the air. The fire is started in the center and controlled by vent holes. Firing methods vary with individual burners. When firing is complete all openings are closed with earth and the mass allowed to cool. Charcoal is uncovered and handled by fork.

Kiln Method

Kilns are usually circular, dome shaped structures, similar in appearance to those used for brick, and vary from 10 to 100 cord capacity. The kiln space is packed as densely as possible with cord wood, slabs and blocks. The fire is started in the top and temperature controlled by adjusting air openings in kiln. When firing is complete all openings are sealed and kiln allowed to cool. The charcoal is removed through the loading doors by conveyors or hand trucks.

Retorts Method

Most of the charcoal in the United States is produced in retorts. They constitute a complete manufacturing plant to produce chemicals from destructive distillation of wood. Charcoal is here a valuable by-product.

(Continued on page 81)

Short tons of charcoal per year

	Probable consumption 1951	Possible future consumption rate 1953–1955
Carbon disulfide	60,000	100,000
Pig iron and sponge iron	25,000	75,000
Domestic use, including briquettes	150,000	200,000
Stock feed	10,000	5,000
Black powder	5,000	10,000
Activated carbon	15,000	20,000
Tobacco curing	10,000	15,000
Other ferrous and non ferrous metallurgy, other chemicals and miscellaneous	25,000	50,000
Total	300,000	475,000

[1] Presented at meeting of Forest Products Research Society, Carolinas-Chesapeake Section, November 7, 1952, at Raleigh, N. C.

Galactan in Western Larch Wood[1]

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A quantitative determination was made by the U. S. Forest Products Laboratory of the galactan in western larch woods and sawmill refuse. This work was done to obtain data useful to those contemplating commercial ventures designed to produce and market various materials made of galactan.

Galactan in the lateral roots of virgin trees ranged from approximately 11 to 23 percent, based on the weight of the oven-dry wood. The galactan content of slabwood from virgin-growth butt logs was found to be about 14 percent; from the middle logs, 4.2 to 10 percent; and from the top logs, about 5 percent. Butt logs from fire-killed virgin trees contained approximately 9 to 16 percent of galactan; the middle logs, 6.6 to 12.1 percent; and the top logs, 6.6 to 7.8 percent. Butt logs of stand thinnings contained from 3.8 to 5.3 percent of galactan; the middle logs, 2.1 to 3.5 percent; and the top logs, 2.2 to 3.1 percent.

Introduction

WESTERN LARCH DIFFERS from most other species of wood in that it contains appreciable quantities of galactan in the form of a hot-water-soluble polymer of arabinose and galactose (*4*, 7).[3] This form of galactan has a re-occurring building unit which consists of one molecule of arabinose and six molecules of galactose (*5*, *6*, 7). It is thus an arabogalactan polymer rather than galactan, as commonly designated. Borgin (*1*) found that galactan from western larch consists of two components having molecular weights of 100,000 and 16,000, respectively.

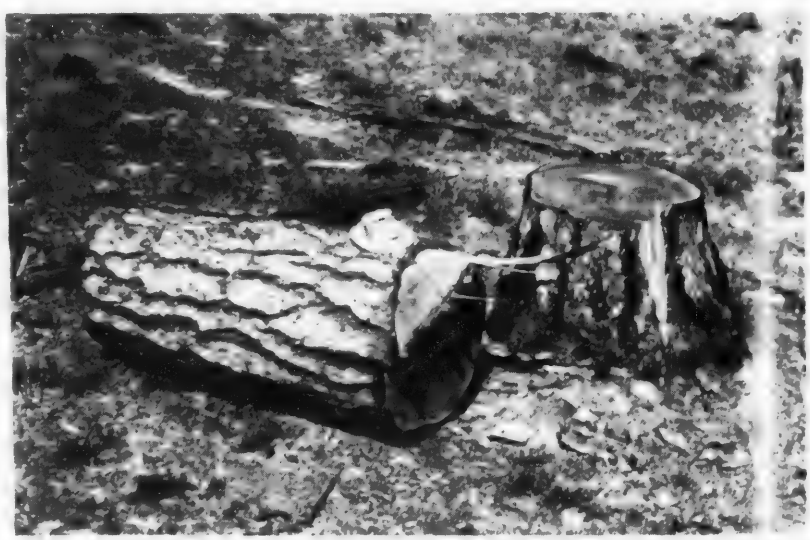
The arabogalactan, on hydrolysis with acid, can be converted to arabinose and galactose. In turn, the arabinose portion can, under more drastic conditions, be changed by means of acid to furfural. The galactose portion is oxidizable by means of nitric acid to mucic acid, which is insoluble in water or aqueous solutions of nitric acid. This is the basis for the quantitative determination of galactose in the material commonly designated galactan.

Mucic acid finds uses in the manufacture of intermediate organic chemical products, among them are baking powder, effervescent salts, artificial yeast, an accelerator of yeast growth, a component of esters and salts for pharmaceuticals, in disinfectants, in acidulants, an ingredient of soft drinks, a component in electroplating baths, and mordants for dyeing textiles. Most of these uses require no large tonnages of mucic acid. Accordingly, new uses would have to be developed before large-scale production of mucic acid would be economically feasible.

Virgin-growth western larch heartwood appears reddish brown in color on the cross-sectional surfaces of the stump and butt log. If the galactan content is high, the reddish-brown color is tinged with blue. On exposure of the cut to summer heat and sunlight, the galactan accumulates in the form of a white powder on the surface of the stump and the cross-sectional face of the butt log. High concentrations of galactan are generally associated with ring shake and rot in the butt log of western larch (*2*). The presence of these two defects led to the practice of loggers to place the top cut for the long butt sufficiently high up the tree so as to eliminate physical indications of the shake and rot. In recent years, loggers have developed uses for the less intense ring-shake stock and, as a result, the discarded butts are becoming shorter and less frequent.

Previously the U. S. Forest Products Laboratory showed that a limited number of samples of wood from the butt log of virgin-growth western larch had an average of 17.9 percent of galactan, and samples of wood from the top log of the tree had an average of 5.9 percent of galactan. In contrast, samples of wood from the butt log of second-growth western larch had an average of only 5.6 percent galactan.

The object of the present work was to determine the percentage of galactan in western larch wood discarded during log-harvesting and lumber-cutting operations in Montana, Idaho, and Washington as a source of infor-



High butt cut as made on western larch to get above shake and rot.

[1] This work was done in cooperation with the Forest Utilization Service unit of the Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Mont. Report No. R1771

[2] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

[3] Underlined numbers in parentheses refer to Literature Cited at end of this report.

mation for anyone who might consider exploring the feasibility of utilizing the material.

Wood Types Tested

Samples of western larch wood that were analyzed consisted of (a) roots; (b) cross sections from the butt, middle, and top parts of fire-killed trees; and (c) cross sections from the butt, middle, and top part of trees removed in thinning operations, and (d) samples of slabwood from different heights of the trees. The wood samples were collected and shipped to the Forest Products Laboratory in December 1948 by the Forest Utilization Service of the Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Mont.

The root samples were collected along a highway constructed in 1948, north of Seeley Lake on the Lolo National Forest. They were from one of the largest virgin larch stands in the Northern Region. Many of the trees in this stand ranged from 300 to 400 years in age. The sampling was confined to lateral roots as it was impossible to remove the main roots of the stumps. Three root samples which differed in surface appearance as grayish, bark-covered, and black, respectively were analyzed.

The slabwood samples were obtained at a sawmill near the place at which the root specimens were collected and represented the same type of virgin western larch as the roots. The test samples analyzed were cut from the slabs at 0, 6, 16, 32, and 64 feet above the stump of the tree.

Samples of fire-killed virgin-growth trees were collected on the Colville National Forest in northeastern Washington. They were taken from an estimated area of 250,000 acres, which was burned over in 1929. The fire-killed trees were still in a relatively good state of preservation, as shown by visual examination of the samples, and constitute a major utilization project of the region. Samples from three trees designated as Nos. 3, 4, and 6 were analyzed.

Samples from thinning operations were taken from second-growth stands of western larch 60 to 80 years of age on the Cabinet National Forest near Noxon, Mont. This area is located on the eastern fringe of the western white pine stands and is considered one of the best western larch sites in the region. It is representative of the type of stand on which thinning would be advantageous. The average diameter of the trees was approximately 6 inches at breast height and their height was approximately 70 feet. Samples from three trees designated Nos. 1, 9, and 13 were analyzed.

The wood samples were reduced to sawdust and the coarse particles eliminated by means of a 20-mesh screen.

Table 1.--Percentage of galactan in western larch root sections and slabwood[1]

Type of material	Number of sample	Galactan	Type of material	Height of sample in tree	Galactan
		Percent		Feet	Percent
Root sections	1	23.0	Slabwood	0	14.1
	2	10.7		6	10.1
	3	16.9		16	4.2
				32	6.6
				64	4.7

[1]Based on weight of oven-dry wood.

Table 2.--Percentage of galactan in fire-killed western larch and thinnings from second-growth[1]

Type of material	Number of tree and location of sample	Galactan	Type of material	Number of tree and location of sample	Galactan
		Percent			Percent
Fire-killed trees ...	3		Thinnings from second-growth stand	1	
	Butt	13.5		Butt	5.5
	Middle	9.3		Middle	2.1
	Top	7.8		Top	2.2
	4			9	
	Butt	15.7		Butt	3.8
	Middle	12.1		Middle	2.3
	Top	7.1		Top	2.5
	6			13	
	Butt	9.2		Butt	5.8
	Middle	6.6		Middle	3.5
	Top	6.6		Top	3.1

[1]Based on weight of oven-dry wood.

Methods and Results of Tests

Galactan in the wood was quantitatively determined by Schorger's method (*3*). It involves treating a given weight of air-dry unextracted wood sawdust of known moisture content with boiling 3 percent nitric acid, filtering, washing the residue with boiling water, adding the washings to the original acid filtrate, concentrating the filtrate, oxidizing the galactose in the concentrated filtrate to mucic acid by means of 25 percent nitric acid, concentrating the mixture, adding a known weight of mucic acid to start crystallization of the mucic acid in the filtrate, and allowing to stand 48 hours. The mucic acid was filtered off, washed, dried and weighed. A correction was made for the mucic acid added and the remainder was multiplied by the factor 1.2 for conversion to galactan.

Analytical data for the root and slabwood samples are recorded in table 1. Yields of galactan from the

root samples Nos. 1, 2, and 3 were 23.0, 10.7, and 16.9 percent, respectively. Yields of galactan from the slabwood at 0 feet height were 14.1 percent and gradually decreased to 4.7 percent at 64 feet above the stump. Being slabwood, the samples contained considerable sapwood which has less galactan than heartwood. The concentration of the galactan decreased with height above the stump and confirmed the results of previous analysis of virgin western larch wood.

Galactan yields of the butts of the three fire-killed trees were 13.5, 15.7, and 9.2 percent, respectively, as shown in table 2; those of the samples taken from the middle of the corresponding trees were 9.3, 12.1, and 6.6 percent; and those from the top of the corresponding trees were 7.8, 7.1, and 6.6 percent.

Galactan yields from the butts of the three thinning trees ranged from 3.8 to 5.8 percent; those from the middle ranged from 2.1 to 3.5; and those from the top ranged from 2.2 to 3.1 percent.

Radial distribution of the galactan in a tree was also determined. To do this cross sections were cut from the butt, middle, and top of the fire-killed western larch tree No. 3 for the analytical work. Sectors removed from the cross sections were divided, parallel to the boundary between the annual growth rings, into outside and inside parts. The radial dimensions of the two parts are shown in table 3 in connection with the analytical data. Galactan content was 15,1, 10.0, and 9.5 percent in the outside part of the sectors from the butt, middle, and top, respectively; it was 8.3, 6.0, and 5.5 percent in the inside part of the corresponding sectors.

Obviously, the roots, the slabwood from the lower 6 feet of the butt log, and the butt logs of virgin western larch trees are rich in galactan. The stumpwood, which is located between the roots and butt log, presumably also contains galactan in yields ranging from about 10 to 23 percent. On the other hand, trees removed by thinning operations are a poor source for galactan. Killing of the trees by forest fire appears to have had little if any effect on the galactan content of the wood.

On the basis of present information, the maximum yield of mucic acid derivable from western larch would be roughly 83 percent of the galactan values reported.

Table 3.--Percentage of galactan according to radial location in sections of fire-killed western larch[1]

Section of tree	Location of sample[2]	Radial dimension of sample	Galactan
		Inches	Percent
Butt	Outside	5	15.1
	Inside	4	8.3
Middle	Outside	3	10.0
	Inside	5	6.0
Top	Outside	2	9.5
	Inside	3	5.5

[1] Based on weight of oven-dry wood.

[2] Each section was wedge-shaped and divided into inner and outer samples with respect to radial direction.

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Committee—From page 5

PhD. in Wood Technology from Duke University. Previous to his present position, he was Associate Professor of Forest Utilization at West Virginia University from 1947 to 1951.

B. E. Clatworthy, who is presently in an administrative capacity in the Home Instrument Department of the Victor Division of the Radio Corporation of America, arranged the program for Session V, on Wood Finishing. The session will cover such subjects as free films of house paint, applications of fillers, and factors affecting the integrity of furniture finishes. Clatworthy is a graduate of Colorado A. and M. College with a B. S. degree in Electrical Engineering. Except for a short training period with Westinghouse following graduation, he has been employed continuously by RCA. His present work is concerned with manufacture of radios, television and record players. Clatworthy is a registered Professional Electrical Engineer.

Memphis—From page 6

an ultra modern city founded on deep south traditions of gracious hospitality, it is possible to enjoy the Memphis scene in complete comfort.

Many ante-bellum homes and magnificent gardens abound in and around the city. Tours of these homes and gardens are conducted by especially trained guides. In addition, there are many beautiful parks, including Memorial Park and Annie Laurie Rose Garden. Beautiful Mirror Lake, Brooks Memorial Art Gallery, the Memphis Open Air Theatre, and Memphis Zoological Gardens, one of the south's finest zoos, are other points of interest.

Prevention of Shipworm Attack on Sawlogs Transported in Rafts[1]

C. O. FULTON

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Tests leading to full scale experiments indicate it may be possible to substantially reduce damage done by shipworms to logs transported by Davis raft. Spraying raft with dilute solution of sodium arsenite may be practical answer.

THE ATTENTION of the British Columbia Research Council was directed in 1949 to severe attacks by shipworms on sawlogs being transported in salt water from the logging sites to the sawmills. A Vancouver consulting forester estimates that this attack results in an average loss of $5,000 per Davis raft.

A questionnaire sent by the British Columbia Loggers' Association to mill operators, and a survey conducted by the B. C. Research Council, revealed that no significant borer damage occurred if logs were not in salt water longer than 3 months. Mill operators stated that there was no excuse for logs being in salt water longer than 3 months if flat booms were towed in inside passages. It was also made clear, that Davis rafts had to be used for transporting logs in outside waters. Stormy weather could retard the towing progress of these rafts to the extent that a Davis raft might be in salt water as long as 3 to 6 months. Thus the problem was to find a method of preventing shipworm attack on sawlogs transported on Davis rafts that must remain in salt water for periods longer than 3 months.

Before discussing this problem further, it migh be well to discuss briefly the life history of the shipworm found in British Columbia waters. This species of shipworm is *Bankia setacea,* commonly known as the Giant or Plumed Pileworm. Although the life history of this species has never been carefully worked out, it probably is similar to that of another species found on the Atlantic coast. The eggs of the Atlantic species, *Bankia gouldi,* are discharged into the surrounding water and are fertilized there. The fertilized egg develops within 3 hours into a free-swimming larva about 1/500 of an inch in diameter. During this stage, which lasts about 1 month, a typical clam shell and a tongue-like foot develop.

After this free-wimming period the larva attaches itself to a suitable piece of wood, the clam shell changes into a shell of the borer type, elongated syphons are protruded, and boring begins. Twenty days after attachment the Atlantic species is about ½ inch in length, and 30 days after attachment it reaches a length of approximately two inches. At this time, it is sexually mature (it has been estimated that one female can produce one hundred million eggs) and growth of the worm continues until a length of 2 to 3 feet is reached.

The burrow of *Bankia setacea* (the B.C. species) is about the size of a pin pole where it enters the wood. The burrow proceeds at right angles to the surface of the wood for a distance of 2 to 6 inches, enlarging after the first inch to a diameter of ¼ to ½ inch. The burrow then tends to turn at right angles and run parallel to the grain of the wood. If infestation is heavy, the burrows penetrate deeper into the wood to avoid other burrows. Thus, after 6–9 months, untreated timbers 2 feet in diameter, placed in Vancouver harbor, can become honey-combed to the point of complete disintegration.

One can readily appreciate from the rate at which this destructive worm grows, that the logs in Davis rafts are extremely vulnerable to attack. Therefore, the B.C. Research Council undertook preliminary experiments to find a method of reducing the losses in Davis rafts during the winter period of bad towing weather.

Experimental Work

The classical biological method of controlling pests is to attack them when they are in the most vulnerable stage. The best time to kill shipworms would be while they are in the larval stage. However, if one contemplated using a chemical to treat sea water, such tremendous volumes of water would have to be poisoned, that this approach to the problem seems impractical.

A forestry engineer suggested that if a poison could be found that would kill adults already established in wood, the poison could be incorporated into the raft while it was being built. Since logs are collected in a "bag boom" over a period of about 6 weeks before construction of the raft begins, there is ample time for infestation to occur. Incorporation of the poison in the Davis raft might kill the shipworms before serious damage had been done and reduce the period of attack by 6 weeks.

Accordingly, forty chemicals were tested for their lethal effects an adult *Baukia setacea* already established in experimental 2-inch cubical wood blocks. The poison must also be one that is undetectable in lethal concentration. If the shipworms detect something undesirable in sea water, such as one part per million of chlorine, they retract their syphons and plug the pin-hole entrances with two plate-like structures called pallets. It has been stated that shipworms can "hibernate" in this condition for as long as six weeks.

Of the forty compounds tested, sodium arsenite in a concentration of one part to 40,000 parts of sea water, and dinitro-o-cyclohexylphenol in a concentration of one part to 200,000 parts of sea water, were the only two compounds that showed promise of being commercially feasible. Although the dinitro compound was five times more active, its cost was six times as much as the cost of the arsenite. The cost of enough chemical to "fumigate" a Davis raft is estimated to be $300. It is anticipated that the chemical will be sprayed on the raft as a dilute solution, so that only those rafts that have been in sea water for too long a period, would be treated.

Whether the present battle with the shipworm in B.C. will be won or lost, awaits results from field tests which we hope will be made this year.

Discussion

Q. What other chemicals have been tested in your experiments to locate a poison for marine borers?

A. Many have been tried, including Santobrite, phenyl mercuric acetate, copper sulphate, sodium flu-

(Continued on page 81)

[1] Presented at meeting of the Forest Products Research Society, Pacific Northwest Section, Oct. 28, 1952, at Vancouver, B. C.

The Distribution and Control of Oak Wilt[1]

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Presence of oak wilt in 19 states, coupled with losses that have occurred in some areas, mark this disease as a possible major threat to our oak forests. Although relatively little is yet known about the disease, the slowness of its local spread and the apparent absence of an efficient means by which it can make numerous and rapid jumps overland, lend encouragement for control practices.

PATHOLOGISTS, FORESTERS, timberland owners, and oak-using industries continue to be concerned for the safety of our valuable oak forests in the eastern half of the United States, and numerous property owners fear that they may lose their prized shade and ornamental oaks. Oak wilt, caused by the fungus *Endoconidophora fagacearum*, has been known as a killing disease of oak for a number of years; its pathogencity was proved by inoculation experiments in Wisconsin a decade ago. At that time the disease was known in that state and in Minnesota and Iowa. It has been present there for an undetermined time, at least 20 years and possibly much longer.

By 1949 the wilt was known also in Illinois, Indiana, and Missouri. The finding of oak wilt in southern Missouri in 1949 led to the initiation of surveys in the summer of 1950, to determine the distribution and intensity of this rapidly killing disease. Surveys conducted by the Federal Government, with funds provided by the Forest Pest Control Act, and by various State agencies, have resulted since 1950, in the finding of oak wilt in twelve States in addition to the six in which the disease was previously known. The presence of the disease over so large an area and the losses that have already occurred in some places justify a consideration of this disease as a possible major threat to our forest economy.

Symptoms of the Disease

Oak wilt produces very noticeable leaf symptoms on trees in the red oak group. Early symptoms are usually limited to a wilting and bronzing of the foliage in the upper crown, followed by wilting and bronzing of the foliage throughout the crown, beginning at the ends of lateral branches. The bronzing of leaves usually begins at the apex and lobes of the leaf blade, spreading to the midrib, until the entire leaf blade is involved. Defoliation usually accompanies these foliar symptoms, and affected leaves in any stage, including those that are fully green, may fall from the tree. Sprouting along the trunk and larger branches frequently occurs before an infected tree dies. In some cases very little defoliation occurs when a tree dies very rapidly, but usually the defoliation is quite severe. Blackened longitudinal streaks sometimes occur in the sapwood of branches and main stem, but the causal fungus can be cultured from clear wood as well as from discolored, and streaks in the wood are not a definite diagnostic symptom.

The wilt develops more slowly on trees in the white than in the red oak group. Frequently only a single branch dies in a year, but the disease usually persists, killing additional branches annually until the entire tree dies, usually within three to seven years. The failure of oak wilt to develop rapidly on trees in the white oak group presents a serious problem in scouting for the disease; the symptoms sometimes are evident on only a single branch and concealed from view by surrounding healthy branches.

No native oak species is known to be immune to oak wilt. About thirty-five oak species are known to be susceptible, either by natural infections or by infections induced through inoculation experiments. Oak wilt has also killed a number of Chinese chestnuts in a plantation in Missouri. Inoculation experiments indicate that the American chestnut, bush chinquapin, and California tanbark oak are susceptible to oak wilt. Trees of all age and size and with varying degrees of vigor appear to be equally suspectible to this disease.

Oak Wilt Surveys

When the survey for oak wilt was initiated in the summer of 1950, it was found that preliminary scouting for the disease could be done from low-flying airplanes. Healthy and diseased oaks are readily distinguished in a forest stand, even at a considerable distance. Many trees with foliar symptoms only on the uppermost branches can be distinguished easier from the air than from the ground. In a relatively low-speed (70-plus miles per hour air speed) airplane at 200 to 500 feet above the tree tops, a competent observer can locate oaks with discolored foliage for a distance of ¼ to ½ mile.

Trees affected by oak wilt can usually, but not always, be distinguished from oaks dying from other causes. In areas where the disease has not been found previously, trees must be visited on the ground and the causal fungus cultured from specimens collected to make a positive diagnosis.

Green or recently dead wood that has not completely dried out is satisfactory for culturing. Twig or branch specimens, 6 to 8 inches long and ½ to 1 inch in diameter, should be collected from about six places on the tree. These specimens must not be allowed to overheat or dry out, and must be cultured promptly for best results in isolating the fungus.

Airplane scouting for oak wilt has proved to be satisfactory, fast, and economical. This disease cannot always be definitely identified from the air, but areas that do not contain wilted trees can be determined. It is not necessary to send ground crews into forests containing healthy oaks; they check only the suspected trees observed and indicated on maps. From a high vantage point and with the aid of strong binoculars, oak wilt can sometimes be seen for a great distance from the ground, but usually it would be necessary to make an almost 100 percent ground cruise of a dense forest to find scattered, wilted trees that could be seen at a glance for one quarter mile or more from a low-flying plane. Two observers in an airplane, with a third man to handle maps and record tree locations in relation to nearby landmarks, can survey approximately 32 square miles (20,480 acres) of forest land in an hour. It would require several months for the same number of men to thoroughly cruise such an area on the ground.

[1] A contributed paper to the Journal of the Forest Products Research Society.

The surveys conducted by various agencies resulted in the finding of oak wilt in five additional States in 1950 and in seven more in 1951. The disease was not found in any additional States during 1952 but it was found in a number of additional counties in most of the States where the disease was previously known. Figure 1 shows those counties in which oak wilt was confirmed by cultures before 1950, during 1950 and 1951, and in 1952.

The increase in the known range of oak wilt does not in itself furnish any information regarding the yearly spread of the disease. In many areas estimates have been made of the age of the oldest oak wilt infection found in each county. The disease has been present in Wisconsin, Iowa, and Minneosta for 20 years or more. In northwestern Indiana some infections appear to be at least 20 years or more old. Possibly some of the infections in northern Illinois and Missouri are as old. In both the Ozark area and in the East there are a number of infections that appear to be from 8 to 10 years old, but the majority of infections are less than 5 years old.

Evidence now available indicates that oak wilt was disseminated to widely separated and distant points about 8 to 10 years ago. The movement of the disease appears to have been southward and eastward. The development of so many additional infection centers during the past five years indicates that conditions have favored a further buildup of the disease.

No one can now accurately predict what oak wilt may do in the immediate future, or during the much longer period required for our younger oak forests to grow to maturity. An appraisal of the losses in the older infected areas may indicate what can be expected at other places, although nothing is now known about the possible effects that different growing conditions and climate may have on the disease.

Oak wilt has caused considerable damage in many oak wood lots in Wisconsin and Iowa. In some areas of from a few to 80 or 100 acres the mortality from oak wilt is 50 percent or more. In red oaks the wilt kills the stump and roots, and stump sprouting cannot take place. The local spread of oak wilt from tree to tree through natural root grafts, killing root systems and preventing stump sprouting, usually results in death of all oaks in the area. In mixed forest stands, other species are released; in pure oak stands, an almost treeless area results until other species seed in from the outside.

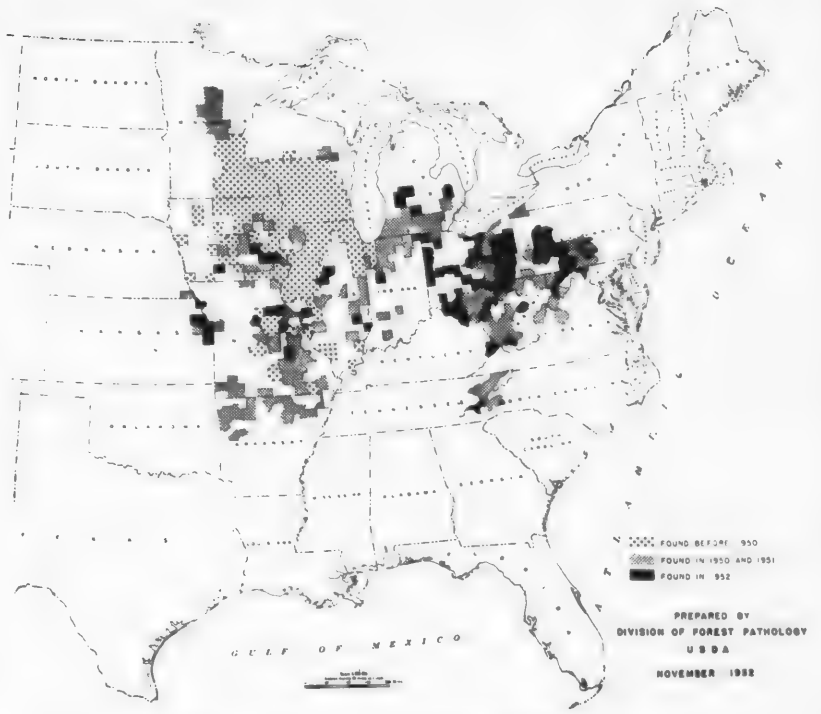

Figure 1.—Distribution of oak wilt in the United States.

Recently the oak wilt fungus has been found to fruit in nature on wilt-killed trees. In some trees, following death, fungus mats form under the bark. These push against the bark and may crack or split it. The reasons for such fruiting on some trees and not on others are not known, nor is it known what part these fruiting structures may play in the long-distance spread of oak wilt. Insects and birds, and possibly rodents, are suspected of being capable of carrying spores from these fruiting structures to healthy trees, but no direct evidence of such dissemination is available.

Lumber, with bark and outer wood removed in slabs, is not thought to be a hazard for spread of oak wilt, but the ability of the fungus to fruit under the bark makes it dangerous to utilize oak-wilted trees with bark attached for mine props, posts, railroad ties, or other products.

Control

The threat of oak wilt appears to be very real. The disease is already known over a very large area, and, if left unchecked, may eventually spread over the entire eastern half of the United States. Losses would be tremendous if the disease should spread through the valuable oak forests of the Ozarks, lower Mississippi valley, and the East as it has through some of the wood lots in Wisconsin and Iowa during the past 20 years.

Our present knowledge of oak wilt, the slowness of local spread of the disease, and the apparent absence of an efficient means by which the disease can make numerous and rapid jumps overland, lend encouragement for control practices. It appears that a vigorous and continuous program can bring the wilt under control in forests in any given area and eliminate new infections as they appear. Control efforts can suppress the disease and reduce losses, but probably will not completely eradicate the disease.

The most effective method now known to suppress oak wilt is to prevent the fruiting of the fungus under the bark on recently killed trees. This may be accomplished by cutting and burning the diseased trees by early fall. Removing the bark from the trunk and larger branches probably will prevent the fruiting of the fungus. If diseased oaks are cut into lumber, the slabs should be burned.

The oak wilt fungus has not been found fruiting on trees after they have been dead for two or three years and the bark has fallen from the tree. Such trees probably are not hazards for spread of the disease.

About half of the infection centers under observation have enlarged through local spread; the others have consisted of a single tree being killed, with no further local spread in subse-

(Continued on page 82)

Wood Storage Problems in the Pulp and Paper Industry[1]

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Deterioration of pulp wood in storage due to fungi and insects results in measurable losses. In one test reported losses caused by fungi over a 13 month storage period increased wood cost by 18 percent. Practicing good woodyard principles are essential in minimizing deterioration.

THE IMPORTANCE of wood to the pulp and paper industry is so self-evident that it seems almost trite to mention it. Few subjects have been so thoroughly raked over as those problems relating to the storage and handling of wood; and, while much of the material I will discuss today is undoubtedly familiar to the pulp and paper men present, its importance to the industry is such that I make no apologies for bringing it up again.

Wood is the most vital and costly raw material used in any of the various pulping processes, and I assure you that a substance of such economic importance to the sixth largest industry in the United States is entitled to, and does, receive considerable attention from both management and technical groups. The base cost of wood, of course, varies in different localities depending on species, labor transportation and individual wood-purchasing policies of each mill. The use of deciduous woods such as aspen and birch was considerably accelerated during the last decade by the changing wood supply picture and the resultant increasing costs of coniferous species. As labor and transportation costs followed the upward trend, however, those deciduous species formerly regarded as "cheap" increased rapidly in price, so that much of the cost advantage in the use of aspen and birch is now due to the inherent higher yields of the semi-chemical processes in which they are primarily used.

All this is by way of pointing out the importance of the problem and the necessity for the pulp manufacturer to protect his investment in the wood he has purchased. In order to emphasize the particular problem of the chemical pulp producer, it is interesting to consider a single bolt of rough green jackpine. This bolt contains about 50% water and about 12% bark, both of which are unmarketable in the finished product. On the 38% remaining, the kraft or sulfite mill obtains a yield of about 45%; in other words, of the total weight of wood purchased and transported to the mill, only about 18% is obtained as a salable product. Groundwood and semi-chemical pulp producers, of course, fare somewhat better because of higher yields.

Weight-to-Volume Ratio

This is all familiar ground to the pulp manufacturer; but to those of you in other fields of wood utilization, it is worth emphasizing in order to indicate some of the fundamental considerations in an industry where the basis raw material is purchased on a volume basis, but sold on a weight basis. The weight-to-volume ratio, or density, of wood is therefore one of the most important properties to be considered. Anything that happens to the wood which tends to reduce this ratio will correspondingly reduce the yield of pulp per cord of wood, with resultant unfortunate repercussions on the pulp mill balance sheet. There are a large number of factors affecting this weight-volume relationship in the wood as it goes to the pulp mill; and all of them have been subjected to thorough scrutiny by the technical staffs of numerous pulp and paper mills. Over such factors as wood species, growth conditions, bark percentages and others we have little or no control once the wood is purchased; and from a practical standpoint, it is a question of doing the best we can with the wood that is available.

There is one factor, however, over which the mill has definite control, and that is in the storing of the wood which they purchase. A quick look around the woodyards of the paper-mills along the Wisconsin and Fox rivers will show that wood inventories in the neighborhood of a million dollars are not uncommon—this figure depending on the size of the mill and the season of the year. The Southern mills have their own particular problems, their ratio of wood inventory to production capacity being much smaller, and their storage conditions more severe.

Our own situations is distinctive in that cutting is done in the winter months and the wood shipped to the mills during the late winter and early spring, so that about June 1, the wood for approximately a year's operation has been cut, purchased, and piled in the yard. The storage of wood therefore represents a considerable tieup of capital, and it is an economic necessity for each mill to protect its desirable properties by proper storage and handling methods.

Causes of Deterioration

Fungi and insects are the principal enemies of the wood-pile. Practically every bolt carries with it the seeds of its own destruction, since some spores or slight fungus growth are almost certain to be present. These fungi are of two general types: the white rots, which are

Sound Wood Yard Storage Practices

1. Use your wood as soon as possible after cutting.
2. Store wood in the peeled condition if practicable.
3. Have the woodyard well drained, clean up rubbish and bark accumulations, and surface it with cinders.
4. Pile the wood in tiers, off the ground if possible, with the piles running in the direction of prevailing winds for good air circulation.
5. Use the wood systematically and in rotation according to length of storage.
6. Never store new wood on an old pile, but clean up the old pile completely, including bark and rubbish, before starting a fresh pile.

[1] Presented at meeting of the Forest Products Research Society, Upper Mississippi Valley Section, December 9, 1952, at Wausau, Wis.

lignin and cellulose consuming, and the brown rots, which primarily are cellulose-destroyers. Richards (1) gives an excellent discussion of the various species of fungi involved in pulpwood decay. Their growth is favored by definite moisture and temperature conditions, such as in rough wood during summer storage. At moisture percentages below 23% or above 55 per cent fungus growth is practically static; consequently, the storage of wood in the peeled condition so as to permit rapid drying will do much to prevent deterioration. Similarly, wood completely immersed in water is almost immune to decay, although this is impractical for most mills.

Deterioration of wood in the yard occurs relatively rapidly during the summer, and is almost nil during the winter in the Lake States area. Weather conditions are a considerable factor in rate of deterioration, a hot, dry summer producing less deterioration than warm, damp conditions. Here again, peeled wood fares much better than rough wood, since the bark tends to hold moisture in the bolt. The possibility of barking the pulpwood bolts in the woods as they are cut has received considerable attention recently, and the availability of portable barking equipment makes this idea worth considering from the wood conservation and transportation angles. The economics of on-the-spot barking are somewhat dubious as yet, since most mills have their own barking equipment, and barking pulpwood in the woods in cold weather is probably not the easiest job. However, the idea has its merits, and the equipment manufacturers are working on the problem.

The action of insects on pulpwood occurs primarily at the cambium layer, between the bark and the wood. The principal effect here is loss of wood substance around the perimeter of the solid wood area. This damage is generally not as severe as that inflicted by fungus action, since the quality of the wood in the rest of the bolt is not affected.

Loss from Deteriorated Wood

The effects of using old and deteriorated wood in the pulp mill provide us with the really sad part of the story. In sulfite pulping, a certain amount of ageing of the wood is customary, since it loosens the bark and reduces pitch trouble on the paper machine. However, Pascoe and Scheffer (2) state that sulfite pulp is more seriously affected by decay in the wood than kraft pulp. As pointed out previously, the principal physical effect of fungus action on wood is the decrease in wood density, with accompanying loss of pulp yield per cord. This effect is shown in Table I and in Figure 1, which show the decrease in yield from a test pile of green jackpine, cut in August, 1947 and stored in the Mosinee Paper Mills Company woodyard for 16 months. It was pulped at stated intervals under standard conditions in the Mosinee Research Department experimental pulping unit.

TABLE I

Date Pulped	Age of Wood	$KMnO_4$ No.	Screened Yield
September, 1947	1 month	20.9	46.6%
June–July, 1948	10 months	22.1	41.5%
December, 1948	16 months	20.3	39.4%

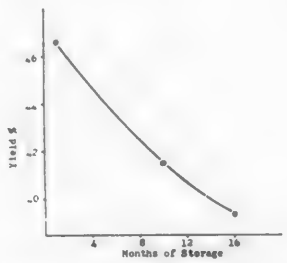

Figure 1.—Decrease in yield of Jackpine pulp from stored wood.

In a similar test made in 1951–52, a test pile of rough jackpine was stored under yard conditions at the Mosinee mill, and the yield results calculated as cords of wood required per ton of pulp. The results are shown in Figure 2. This shows that after 15 months of storage, it required 18% more wood to produce the same amount of pulp that was obtained at 2 months storage. In other words, the additional 13 months storage increased the cost of wood to the mill by 18%. Experimental cooks and TAPPI Standard beater strength tests were made on these pulps; Figure 3 showing the Mullen vs. Tear curves for the 2-month, 5

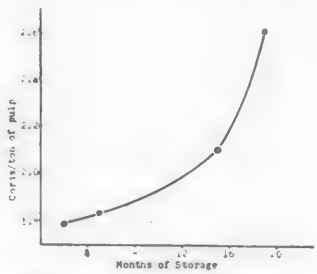

Figure 2.—Cords required per ton of pulp using stored wood.

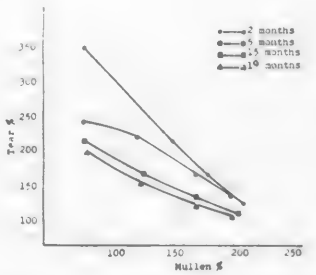

Figure 3.—Relative strength curves of pulps from stored wood.

month, 15 month and 19 month pulpings.

In 1947–49, a cooperative study of wood deterioration on a commercial scale was made by 4 northern kraft mills, of which Mosinee was one, in conjunction with Forest Products Laboratory. Pulp made from wood at various storage times was made into a standard grade of paper on the paper machine, which showed a 13% loss in mullen and a 9% loss in tear between the first pulping at 7 months storage and the second pulping at 11 months storage.

The question naturally arises as to what can be done by the individual mill to prevent or reduce to a minimum these losses in pulp yield and strength, which are certainly translatable into dollars and cents loss to the pulp mill. There is no new panacea for the prevention of wood deterioration, but practicing the principles of good woodyard practice will help materially.

The availability of wood in this country is not such that we can afford to waste it. Plenty of evidence is available from the literature and the personal experiences of pulp and paper mill men to show that wood deterioration exacts penalties in cash and quality from the pulp producer. It should be apparent that the study and practice of proper wood utilization methods will pay good dividends, and benefit all of us who are dependent on the tree and its products for our daily living.

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Laminated Ship Construction Practices[1]

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Fabricating numerous large and small laminated members for wooden minesweepers calls for adaptation of modern laminating techniques. Carefully controlled production practices make glued-up bow stems, frames, skegs and keel sections possible.

THE CALL WENT OUT from the Navy Department in 1951 for an extremely urgent shipbuilding program. Korean waters were infested with a new type of mine which was more sensitive to steel vessels than any before encountered. Newspaper stories described the heavy toll of Navy minesweepers taken by these mines. Something had to be done. The logical answer was to turn to a wooden minesweeper with as little magnetic property as possible. That sounds easy but such craft call for exceptional engineering effort and for unusual shipbuilding achievement.

Both of these difficult demands have now been met. The engineering feat of designing a "non-magnetic" vessel has been accomplished by the Navy Bureau of Ships. The difficult building job is being done by the several shipyards in the program. The Navy has branded this project the most important shipbuilding program under way.

In building all-wood ships of this size, 165 feet in length and 30 feet beam, we are really returning to the days of the clipper ships. We are going back to the giant wood bow stems, oak ribs, and other immense members hewn from the virgin forests of 100 years ago. But, we are going back to those days in theory only. The giant stands of virgin oak and fir are no longer available from which these huge sections can be cut and shaped to the desired size and specifications, so we must improvise. How can we make bow stems, frames, skegs—the thousand and one smaller ship sections—out of solid wood, strong enough to withstand the strains and stresses of modern warfare?

To the Bureau of Ships and the Forest Products Laboratory at Madison, Wisconsin, are due the large measure of credit for the processes worked out to answer the foregoing question. The late Andrew J. Higgins, a pioneer in wood lamination, was experimenting as early as 1922 with the lamination of wood in the building of barges, and later with laminated sections for landing craft and PT boats. Being a pioneer in the field, Higgins, Inc., worked out some very efficient devices for carrying out the theories, propounded by the Laboratory and the Bureau of Ships, in fabricating the current, large, laminated sections.

Lumber is carefully selected in the field, and shipped to the mill, where it is again screened for quality. It is kiln-dried and inspected for moisture content, which must be in a range, for oak, from 8 to 15 percent; and for fir, from 6 to 13 percent. The oak is screened for elimination of sap, government specification allowing only 25% sap. It is also selected for grain pitch. The white oak used comes from Louisiana, Arkansas, and Mississippi The fir comes from Oregon.

One of the big jobs is end-joining the lumber to make long lengths. This is done with scarf joints. These joints may be cured in a hot press in 16-20 minutes. The operator tacks the scarfs before they are placed in the machine. This prevents them from slipping as pressure is applied. The tacks are removed afterwards. Scarfing is also done at Higgins by means of a high-frequency electronic machine, and this is actually the best scarfing method. The machine handles 8 scarfs at one time and takes three minutes to complete the glue cycle.

The long scarfed planks are made up of varying sizes of smaller lengths to permit proper staggering of joints when the long lengths are assembled in the jigs. When scarf joints were spaced at 3-foot, 6-foot, and 9-foot intervals, the laminars can then be assembled with properly spaced scarf joints, relative to each other, allowing them to fall in their proper sequence. The exact lengths of the laminars have been determined from actual operations. The lengths of the planks are not mixed in one laminar.

Once the laminars are scarfed to the proper length, they are sent to the mill for dressing. They are then ready for the glue. Meanwhile, a jig is prepared. This most complex jig is used to make a frame, or rib section. There are many ribs in each hull of the minesweeper, each them slightly

[1] Presented at meeting of the Forest Products Research Society, Deep South Section, November 7, 1952, Baton Rouge Louisiana.

Large deck beam being fabricated in the spar press. Complementary dies are used to provide desired contour.

Laminated ribs are cleaned and sanded, previous to shaping in this specially designed setup.

different from the others. This means that the curve of the plate, against which the laminars will be pressed must be changed slightly in shape for each rib frame. However, we can often fabricate 10 individual sections before changing the jig. Beneath the jig plates, and under the surface of table, are a large number of steam coils to supply much of the heat and also jets for live steam to give necessary humidity.

The laminars are stacked in order for feeding into the glue machine, and then laying up in the jig. The shortest laminars, those which will end up at the keel of the rib frame, are on the bottom of the stack, to be added last. These are shorter than the first laminars because it is necessary for the rib to be thicker at the keel than at the sheer.

The glue machine is a double-roll spreader, run at the rate of 180 feet per minute. The glue is mixed in accordance with the manufacturer's specifications—100 parts of resin to 20 parts of hardener, by weight.

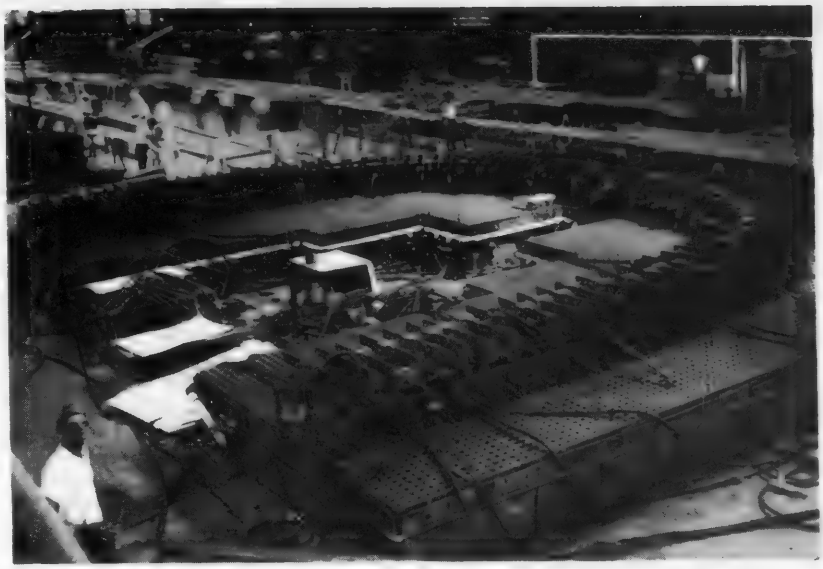
The laminars are run through the glue machine one at a time, then placed against the plate of the jig. A thermocouple is placed at the center of the frame or rib in order to read the temperature of the glue while curing. This thermocouple is installed at the innermost glue line.

The first clamp to be brought over is at the keel position of the rib. Steel plates are now added to the outside of the laminars. Between these plates are two air hoses. Air under high pressure will be forced into these hoses between the plates. These keep the laminars solidly against the jig, regardless of shrinkage which takes place during the curing process later. This eliminates the necessity for constant tightening of clamps, throughout the period of fabrication, and overcomes the human element in this operation.

The pre-marked laminars are carefully checked for position in the jig. This insures that the rib frame will come out as planned, that all laminars are in their proper places and that scarf joints are spaced as desired. The clamps in the immediate keel area are tightened, and now we are ready to bend the longer laminars into the "U" shape, around the jig.

After the laminars are in final place, a hundred hands work feverishly to tighten the clamps with air guns. The laminars are bent carefully, making sure they fall evenly and squarely around the curve of the jig. The laminars must be in place and pressure exerted within a specific

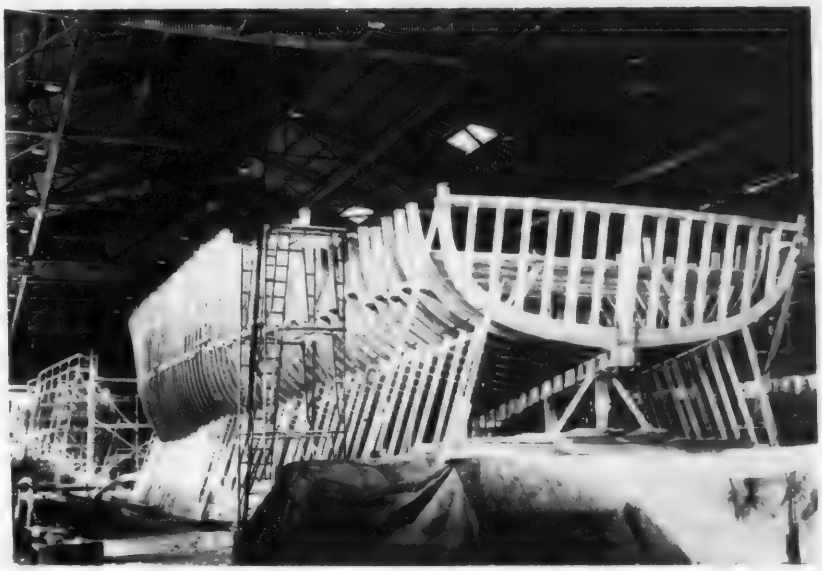
(Continued on page 82)



Rib section jig with clamps in place. Jig holds two rib frames, one above the other. Jig table covers steam coils and jets used for heating and supplying humidity.

Fir skeg or deadwood shown in its special jig.

Scarfs cut on lumber to be end-joined. The end block provides protection to the scarf until the boards are ready for gluing.



Stern view of ship as construction is under way. Transom has just been placed.

A Basic Undergraduate Curriculum in Wood Utilization[1]

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Pennsylvania State Forest School

The following is a suggested program to train men for wood utilization work. Summer work, with credit given, is seen as a needed requirement.

CURRICULUM BUILDING is one of the major headaches acquired by an educator. The results seldom satisfy anyone, including the professor whose brain child it is. At best, the final product is a compromise with many factors too numerous to mention here. No claim is made that the proposal given below is the final answer to the problem or that such a program could be activated in most cases without some changes to meet the educational policies and specific requirements of the institution involved.

The program suggested here is based on 140 credits[2] for eight semesters, exclusive of military training, physical education, and summer sessions. In some institutions military science is not required or even given. Some do not give credit for it—or for physical education—even when required. This policy is a sound one, since many marginal students are able to hang on for another semester or two, thanks to high grades in these subjects which require little mental effort. Such students generally fail eventually and the sooner they are removed from the college or transfer themselves to curricula more suited to their talents, the better for all concerned.

Credit is, of course, given for the work done in the summer sessions. Obviously the course content of the summer program could be worked into the regular eight-semester schedule if desired, by either cutting down the number of technical electives or by increasing the course load. Since it is assumed that Utilization curricula will be given in schools or departments also teaching general forestry which always requires a summer camp, parallel summer requirements seem desirable.

The proposed basic curriculum is admittedly weak in non-technical courses. Advocates of high concentrations in humanistic subjects will not be satisfied. More can be added at the expense of technical training if such is the institutional policy.

The proposed program has been on a foundation of engineering and related subjects and may not satisfy some of the engineers in the utilization field because of its incompleteness. However, the curriculum should be adequate for most purposes. Such a background seems necessary in the light of this writers' experience to meet the demands of industry for men with the essentials of engineering.

Those advocating strong preparation in business administration, commerce, finance, and economics probably will feel that much of the basic engineering, mathematics, physics and such is unnecessary. While it is certainly true that many successful programs in business administrations are built along other lines, there is at least one established curriculum in industrial administration which is based on engineering. From the viewpoint of the college, a multiplicity of widely divergent curricula, especially in the same department or school, is undesirable since administrative difficulties are greatly increased.

The curriculum suggested here will not find favor with the conservation element among the foresters who are convinced that anything concerned with production and use of forest products can be adequately mastered by a fifth year of specialization added to the usual undergraduate program of general forestry.

Limitations of time and space prevent any consideration of the problem involving programs of study on the graduate level at this writing. Again many factors must be considered in any attempt to formulate such a plan. However, the following comments may be helpful.

While a master's degree will probably be very helpful to those students who desire more thorough training in some particular phase or field of utilization, or who are definitely research minded, many more will profit more fully by completing the requirements for a second baccalaureate degree in one of the several engineering curricula or in business administration. A careful selection of electives should make this possible in a relatively short period of time assuming that the proposed basic curriculum is accepted.

Consideration should also be given to a graduate program for engineering students who wish to establish a career in the wood-using industries. It is suggested that institutions with graduate professional schools of forestry or possessing outstanding graduate faculties and facilities investigate the possibilities of establishing a program of study not exceeding one calendar year in duration for the purpose of providing basic instruction in wood technology and utilization for graduates of industrial, mechanical and civil engineering curricula who seek employment in the wood-using industries.

Similar post-graduate programs might also be considered for graduates of business administration and other curricula. However, if the engineering approach is considered desirable, it would be almost impossible to provide a suitable post-graduate program in a reasonable length of time.

Entrance Requirements. English 4 credits; algebra, 2 credits; plane geometry, 1 credit; solid geometry, ½ credit; trigonometry, ½ credit; physics, 1 credit; chemistry, 1 credit; electives, 5 credits. Total credits required 15.

Mathematics. Not less than 12 credits. Program should insure adequate preparation in differential and

[1] Report prepared for the Committee on Training Men for Forest Products Industries, Northeast Section, Forest Products Research Society. Resume presented at meeting of Committee on Education, Forest Products Research Society, Milwaukee, Wisconsin, May 22, 1952.

[2] A credit requires three hours of the students time in class and preparation per week. For example, a 3-credit lecture course would require three hours in class and six hours of preparation per week. A 5 credit course might require three hours of lecture and recitation, four hours of laboratory, and eight hours of preparation.

integral calculus. Mathematics requirements in engineering curricula vary greatly, sometimes as much as 8 credits. Statistics and mathematics of finance are desirable electives in addition to the above.

Botany. Six credits of general botany or 3 credits of general botany and 3 credits of elementary zoology, or 6 credits of general biology. Three credits of general botany will be adequate if the contents are tailored to fit utilization needs. Emphasis should be placed on plant structure.

English Composition. Two 3-credit courses in English composition including composition, rhetoric, narration and description, and one 3-credit course in business English or technical writing.

English Literature or Speech. Three credits.

Drawing. A minimum of 4 credits, two each in engineering drawing and descriptive geometry.

Physics. Ten credits is about average for engineering curricula. The usual courses cover mechanics, heat, sound, electricity, magnetism, light and modern physics.

Chemistry. At least two 3-credit courses which should be fundamental and permit follow-up courses if desired. Many engineering and science curricula require 8 or 10 credits in this subject.

Applied Mechanics. At least a total of six credits in statics and strength of materials. Dynamics and mechanical properties of engineering materials are desirable electives.

Economics. Principles of economics, 3 credits, and a 3-credit elective.

Basic Forestry. Survey of forestry, 1 credit; dendrology, (two courses), 4 credits, elements of forest mensuration, 3 credits; silviculture, 2 credits; management, 2 credits. The last two courses are without laboratory and field work. Some authorities have expressed doubt concerning the need for any silviculture and management in utilization curricula. However, others believe that some information in these areas is desirable for proper understanding of problems influencing both forest production and utilizatiton.

Basic Wood Technology and Utilization. Wood structure, 2 credits; wood identification, 2 credits; physical and mechanical properties of wood, 3 credits; Seasoning and Preservation, 3 credits; agencies of wood deterioration (combination of pathology, entomology, etc.), 3 credits; lumber grading, 3 credits.

Basic Engineering. Industrial organization and administration, 3 credits; elements of electrical engineering, 3 credits; elements of power engineering, 3 credits.

Citizenship Elective. Any 3-credit course in history, political science, and sociology. This is a "must" requirement in land-grant colleges.

Non-technical Electives: Six credits in any of the following: foreign languages, English literature, history, art, music, philosophy, political science, psychology, and sociology.

Professional and Technical Courses. Thirty-two credits total, content depending upon the major selected.

Basic Military Science. Credits for Army and Air R. O. T. C. have not been included. Some institutions do not have these subjects at all, some give the basic courses without credit, and others grant 6 to 8 credits. Advanced courses are given for credit and must be subtracted from the thirty-two credits allowed for professional and technical courses above. Navy R. O. T. C. is a more highly developed program and would probably require some adjustments in the suggested program. All Navy R. O. T. C. courses are three or four credits.

Physical Education. Physical education seems to be a general requirement during the first two years of college. Some institutions give a total of four credits for the subject; others give it without credit.

Summer Session. An eight-credit summer program immediately after the sophomore year is suggested as follows: woodworking machines, 3 credits; wood industries inspection trip, 2 credits; factory planning, 3 credits. Such a program would require eight weeks.

Industrial Engineering Major. Required courses: Engineering laboratory (machine shop, welding, foundry, etc.) 3 credits; electrical engineering laboratory, 1 credit; power engineering laboratory, 1 credit; lumbering, 3 credits; veneer and plywood, 3 credits; wood finishing, 3 credits; wood using industries, 3 credits; technical electives (engineering, forestry, wood technology, etc.), 15 credits. Total, 32 credits.

Industrial Administration Major. Required courses: wood-using industries, 3 credits; lumbering, 3 credits; veneer and plywood, 3 credits; wood finishing, 3 credits. Electives in economics, commerce, finance, business administration, forestry, etc., as directed by school policy, 20 credits. Total, 32 credits.

Logging and Milling Major. Required courses: forest protection, 3 credits; logging, 3 credits; milling, 3 credits; surveying, 3 credits minimum; forest improvements I (roads, trails, communications, etc.), 3 credits; forest improvements II (bridges, frame structures, sanitation, etc.), 3 credits; engineering laboratory, 3 credits; electrical engineering laboratory, 1 credit; power engineering laboratory, 1 credit; technical electives, 9 credits. Total, 32 credits.

Other majors. Majors in forest products merchandising, light building construction, wood technology and others could be established within this framework of 32 credits. By substituting a summer camp in place of the summer-session program suggested above, a satisfactory curriculum in general forestry could be made. The basic forestry classes listed should be strengthened by adding separate field and laboratory courses in silviculture and management and by providing more advanced courses work within the 32-credit frame work. Some substitutions and alterations might be necessary.

Summer Employment. Summer employment has not been made a required feature of this program at this time. If and when a sufficient number of cooperating wood-using industries guarantee to provide summer employment at a wage at least adequate to cover living expenses, this requirement may well be added. Until such time, all students should be urged to find summer employment in the wood-using industries for one or two summers. Pressure can be applied by giving priority to such men when recommending for employment after graduation. In all probability, little pressure will be needed if the summer jobs become available at a living wage.

Research—From page 9

They were told that there was no job opportunity except in some federal, state or municipal service. I believe this will change and change rapidly, due to the fact that industrial and private timberland owners will become impatient with the slow moving process of getting relief through some governmental agency, although Federal and State governments own nearly two-thirds of the merchantable timber supply in the United States. Then there will be a far greater demand for men in these fields than there are scientifically trained specialists in this country.

There is still another difficulty and that is to find capable entomologists, pathologists, etc., who will enter the field of education so as to give more men scientific training. So far as I see it, anyone taking the forestry course should, at the end of the second year, give very serious consideration to becoming entomologists. So far, the deans of these several forestry schools when asked the question "where will I get a job?" have been at loss to make a satisfactory answer. I think, however, that situation is changing and will change rapidly, as I have said before.

Education Needed

This whole business of forest research needs a more intense national educational campaign. Too many people take the forests and the products therefrom as a matter of course. If we are to continue to have the forests as we know them, then there must be an awakening on the part of both government and industry and people to the needs of the situation. Judging from past experience, faster progress will be made through individual and industrial effort. Forest products research in utilization is one of the most important items we must depend upon if we are to be faced with an increase in the population by three million or more people each year and still expect to maintain the same standards of living.

In my opinion, this business of growing trees, harvesting and utilizing the products of the forest and also the by-products, which may originate in some process for the utilization of wood, is one of the greatest economic factors which everyone in the country should be interested in and should support to the limit.

I want to commend you for the efforts you are making along your particular line.

Chipcore—From page 20

Two mixers, of the horizontal, cylindrical type with bars mounted on the horizontal shaft as agitators, are employed in the operation. The resin is sprayed in a fine mist. Chips are dumped from the mixers onto a belt and conveyed to a storage box. Then each tray load is weighed in smaller containers on an ordinary platform scale.

The weighed chips are then dumped by hand onto a tray filling spreader. The spreader consists of a moving belt, the width of which is equal to that of the board being formed. The belt moves the loose chips under a needle-type doctoring arrangement, which permits only the desired depth of chips to pass over the end of the belt. As the chips fall over the end of the belt, a second flexible needle-type spiked drum disintegrates those clusters formed by the tendency of the chips to "ball-up". The chips then rain down onto the cauls below. The whole spreading assembly moves back and forth across the caul three or four times in laying sufficient thickness of chips for one ¾ in. slab.

A final touching up by hand is necessary. Loose chips are then tamped lightly at the edges to give the mat some degree of stability. The sidewalls are removed and the loaded caul is pushed into the press loading rack.

Due to the fact that no pre-press is used in this operation, approximately 6 in. of daylight is required in the press. The press loader is a simple elevator rack type. The cured slabs are cooled in storage, trimmed and sanded to thickness.

Summary and Conclusions

There is little apparent difference in Chipcore material preparations and formulas, whether they are of foreign or domestic origin. The true differences in any one process as compared to another lies in the type of chip and in the methods of coordinating into a single operating unit the various components of equipment necessary in a Chipcore plant. The choice of chip is governed to a great extent by the physical characteristics required of the finished product and by manufacturing cost of the finished product. For example, we do not believe that we, in America, could tolerate a production of 350 pounds of green chips per man hour from a $4,000.00 machine. Nor could we operate economically with a labor cost of 50 or more man hours per 1,000 square feet of ¾ in. Chipcore, when that Chipcore is to be sold in competition with lumber and plywood core materials.

The European has developed both process and market for wood-particle products. He has certainly gained considerable experience in the more than ten years that the products have been manufactured and accepted by the consumers. The development and use of particle boards in Europe has been accelerated by the higher cost of lumber and, hence, the relatively greater desire and need for conservation.

We saw no product in Europe that could not be duplicated in America with American-manufactured equipment but we came home with the strong impression that European plants and products were not completely suited to American conditions and markets. We feel that the splinter-type board has a much wider potential as a replacement for lumber core, etc., and that American plants and processes can produce such material in this country more economically than the European counterparts.

German Furniture—From page 24

Safety

The German factories seemed to have more mechanical safeguards for cutting machines that we do in America. These guards are required by law. However, there are few posters or other means used to bring the matter of safety forcibly to the attention of the workers. Although the writer has not compared the official accident frequency rates for the furniture industries of the two countries, it is his observation that the American type of safety program is more effective than the German.

Conclusions

A general observation of the West German furniture production methods can be made as follows: There is a higher percentage of American factories that are very efficient, but the best German factories are the equivalent to the best American. Except for the more prevalent use of conveyors in the American factories, there is no method or machine in use in the United States factories that is not in use in a furniture factory somewhere in Germany.

If some German factories are very efficient, why have the majority not changed to better methods? It is the writer's observation that the majority do not know the best methods. There is not the free interchange of information between factories within Germany nor between the different countries of Europe. Technical assistance under ECA and MSA would be

much cheaper and just as effective in the furniture industry if the German and other European techniques interchanged information and visited each other instead of coming to the United States. One other factor limits the introduction of better methods. An extremely high corporation income tax greatly curtails the purchase of new capital equipment out of earnings. Since there is very little free capital available for investment in Germany, a company desiring to purchase new equipment finds it extremely difficult to obtain the funds to pay for the equipment. The interest on bank loans is higher than the normal profit of a furniture factory. It would appear that a change in corporate tax policy in Germany would be one of the greatest helps to increased productivity.

Productivity is based not only upon mechanization of industry, but also upon the speed of the individual workers. There were exceptions in a number of places, but the average European furniture worker performs at a slower pace than the average American. Although the number of plants visited was too small to constitute a scientific sampling, the rate performance of the individual European furniture worker seems to vary inversely with the degree of socialization of the country and the strength of the national union in the workers' plant. A faster work pace as well as better methods and equipment would increase productivity in German furniture factories and allow the payment of higher wages without increasing the prices of the product.

It appears to the writer that the details of all the best American methods are known to some of the German furniture factories. The application of these methods to the industry as a whole will be a very slow process unless there is some change in policy of exchange of technical information, corporation income taxation, and union work restrictions. Most of the continental European furniture manufacturers feel that such policies coupled with the creation of a European customs and currency union would create the greatest industrial boom that Europe has ever known. Based upon 1952 observations in West Germany and other European countries, it is the writer's opinion that we in the United States had better be careful how far we travel the road of restrictive policies or our annual increase in productivity and standard of living might begin to fall rather than rise.

Log Grades—From page 27

since much of the difference may be caused by factors other than the physical characteristics of the log, such as the skill of the sawyer, the market conditions and local demand especially with a small mill, and the kind and condition of mill machinery used.

2) Lumber produced from cull birch and maple logs is nearly equal in grade and value to lumber produced from merchantable logs of comparable size and form.

3) Small hardwood logs yield very low value lumber and cannot be cut profitably for factory lumber.

4) It is economically feasible under present market conditions to carry on improvement cuts in second growth hardwoods of a type that will accomplish the first two silvicultural aims mentioned earlier, that is, removal of cull trees and reduction of poor growing stock in favor of well-formed thrifty trees. However, the third aim, thinning the pole sized trees, cannot be accomplished until new uses and markets are developed for this kind of material.

Therefore, the more uses forest products research can develop for small or defective materials, the better the job the forester can do in the woods.

Gangsaw—From page 29

sweep, and even those with moderate crook, can be advantageously converted into one-inch lumber.

Mill Power

This mill is powered with a 6-cylinder diesel motor of 120 h.p. Supplementary power is provided the jackladder, green lumber transfer chain, log deck transfer, saw feed-rolls, and gangsaw dust chain by a series of strategically placed small, electric motors with V-belt drives. In fact, the heavy motor only operates the gangsaw and the hydraulic system. All other powered units are driven by electric motors.

The in-feed saw carriages return by means of a travel limit trip switch with an overhung weight and pulley arrangement. At the end of the forward movement of the infeed carriages they interlock and return as a unit. The delivered saw did not provide for other than manual introduction of the log into the saw. This has been remedied as shown in the accompanying picture. An electric motor drives a small, rubber-tired, wheel through a gear reducer. The unit is spring-supported and the wheel is made to contact a narrow rail by means of foot pressure. Once the log is in the saw the feed rolls take over.

Mill Efficiency

The mill operates with a total of ten men. This means a production rate of about 1500 board feet per man per day. This is good production.

Preliminary records indicate that a mill of this type can be made a very efficient processing medium. On a single day's run it was found that rough green lumber tally exceeded net log scale (International 1/4" Log Rule) by eight per cent. The efficiency of this gangsaw stems from the following points: (1) lower green thickness board possible because of the uniform cutting of saws; (2) reduction in saw kerf; (3) greater average length of lumber; (4) reduced amount of slabs; (5) ability of saw carriages to keep sides of log parallel to plane of saws; and (6) uniform sawing approach reduces sawyer error.

This type of round-log gangsaw offers interesting possibilities for milling southern pine in many areas of the South.

Vacuum Treating—From page 33

Fence posts and lumber have been the two main items treated in this plant. The tank will hold 100–200 posts or 1000 board feet of lumber per charge. Charges of easily treated material can be run in as little as 1 hour. In operating the plant, the material to be treated is placed in the tank, the cover is set in place, a vacuum is drawn to remove air from the wood cells and the preservative is then drawn into the chamber by means of the vacuum. After the material has been covered with preservative, the vacuum is released and the oil drained back to storage tanks after any desired period of soaking. A final vacuum usually is drawn to remove excess preservative.

The plant can be constructed for less than $6000. A plant of this type should supplement rather than substitute for pressure or hot-cold bath treating plants. These low-cost installations should help make treated wood available to many localities not conveniently situated with respect to the existing commercial plants.

Much added research is needed to fully evaluate the advantages and limitations of this type of treating equipment for various species and forms of wood products.

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Creosoted Plywood—From page 35

Q. Was there any difference in the glue bond strength of the creosoted panels?

A. No difference found from the tests done by a plywood manufacturer.

Q. Does creosote bleed through paint?

A. Yes, I have samples of creosoted plywood here which you may examine later which have been partly painted. Aluminum paint was applied on these samples which have been treated with approximately 12 points of creosote per cubic foot of wood and a white paint applied on top of the aluminum paint. You can see that the creosote has stained the white paint, showing the grain pattern of the wood underneath. It will not show, however, on the aluminum paint alone.

Q. How did you arrive at the 24, 16 creosote solution? Did you try 20, 18, 22, etc.

A. The attack of marine borers can be very severe and we felt it was absolutely necessary to get as much oil into the plywood as possible. We settled at 24 pounds retention because our first tests approximated that.

Q. You try to push as much as possible into the plywood?

A. Generally speaking, yes. It depends on the final use what retention is required.

Q. Have you any service record of pontoons?

A. No, not extending over many years. The Westview pontoons, our best example, were in place August, 1951 and to this date are standing up very well.

Q. Have you plywood samples here that show the maximum treated plywood?

A. No, I did not bring them out because they are rather dirty to handle.

Q. You mean you have considerable bleeding?

A. Not exactly. The plywood for marine use has a very heavy retention and naturally the plywood is saturated with creosote. It depends entirely on the way it is treated and the end use. We use a final vacuum to ensure that surface is not too oily. With the pontoon we tried to keep the surface clean for easier handling and construction.

Q. Have you had any experience with treating mountain Douglas Fir plywood with pressure creosoting?

A. No. I have not seen any literature on that.

Q. What is the cost of the 24-pound treatment?

A. That is something that I can't answer offhand. The price is determined a great deal by the quantity treated. To get a proper treatment we feel the plywood should be treated by itself. If not, as in the case of plywood for marine use, we have to take exceptional care, which is costly, in putting it in with other materials.

Q. What would a full tank at a time cost?

A. I'm sorry, but I couldn't tell you offhand.

Q. What is the thickest plywood you have treated?

A. We have treated 1-inch thickness with complete penetration.

Package Durability—From page 40

These boxes were exposed in the weather for 18 months, and part of the time they were buried in ice and snow, and during the summer months exposed to the hot sun and summer weather conditions.

At the end of the test, boxes which were dipped in Sealer, as well as the untreated boxes, were in very bad condition. The plywood had separated badly, and the packing paper was wet and full of mould and mildew. The cans in these boxes were badly rusted and the screws which held the covers on were so rusty that the threads were entirely gone. By contrast, the water-repellent preservative treated boxes were dry inside, and the plywood was still in good condition; the packing paper showed no signs of excessive moisture, and the cans were bright and shiny, and also the screws were bright and shiny, all except the heads (See Fig. 1).

Small boxes with cleated ends were also constructed and similar tests run. After only 30 days exposure the untreated cases were wet inside and full of mould and mildew, and the cans as well as the screws were rusty, while the treated cases were in excellent condition (See Fig. 2).

In making up test boxes from Pine as well as hardwood lumber, we found that on exposure in the weather there was a great deal of distortion taking place after each rain, and the covers and bottoms would tend to warp away from the box, and while they were wet swell and extend beyond the sides (See Fig. 3).

When these boxes were opened we found the same condition existing inside that we had found in the plywood boxes, in that the paper was full of mould and mildew and wet, and the tin can rusted, and also we would note serious rust stains around the nail or screw holes which were not present in the case of treated boxes. In the treated boxes, without fail, the contents would be dry and the can bright and shiny, as well as the nails or screws (See Fig. 4).

In examining these exposure boxes, arrangements were made to open them and photograph the contents each 30 days. In the untreated boxes, a surprising increase in the amount of mould and damage to the cans was found as time went on, whereas the treated cases would remain in practically the same condition throughout the test (See Fig. 5).

Some cases were treated on one-half only: that is, after the case was completely fabricated it was dipped in a water-repellent preservative just halfway up on the case, and then after drying exposed in the weather. In many instances, after six or eight months exposure the untreated half of these cases would be no longer serviceable while the treated half would be in excellent condition (See Fig. 6).

Where a camouflage effect is desired, 4 oz. by weight of asphalt or gilsinite can be added per gallon of preservative, to create an earth-brown color, and this proved very effective during the last war. Water-mix brown stains were used during World War II, but they tend to wash out of the wood, and tend to stain the lettering, making it more difficult to read. The water-repellent type showed very little effect upon the color of the letters (See Fig. 7).

Now as to the preservative features let us refer to Fig. 8, which shows two box-like test structures which had been out in the weather for 7½ years. The one on the left had been given a 3-minute dip in a water-repellent preservative, while the one on the right was not treated, and was entirely destroyed by the weather. The treated one was in excellent condition.

Figure 9 shows a block of wood which was treated on one end only with a 3-minute dip in a water-repellent preservative and then exposed in a termite nest in the laboratory for six months. Note that the termites ate a hole thru the untreated end, and decay and checking also set in during that period, while the treated end was free of these conditions.

Charcoal—From page 65

Location of such a plant is dependent upon a large wood supply, rail, water and power facilities and proximity to markets.

A single retort consists of a dryer, carbonization chamber and a cooler. They are rectangular steel chambers open on each end by doors. The wood is placed in steel buggies and pushed into each operation as a semi-continuous process. The fuel for the carbonization chamber is coal or natural gas supplemented by waste wood gas and tar. The charcoal is unloaded, handled and packed mechanically.

Continuous Methods

There are a number of continuous methods used by various companies some of which are controlled by patents. These can generally be described as rotary kiln and the blast furnace type. The Lambiotte method developed and built in France is the best known.

Coosa Charcoal Company was formed in 1951 to investigate and study the production of charcoal from southern hardwoods. After considerable study the kiln method was chosen as being the most economical to produce charcoal of suitable quality for the chemical industry. Design of the kilns was patterned after those used by West Virginia Charcoal Company, whose sole output is used for the production of carbon disulfide. The two kilns are 20 feet in diameter, 14½ feet to the crown and hold approximately 35 cords of wood. The complete cycle takes about 23 days. The kilns are red brick construction, with 13 inch walls, steel doors and steel reinforcing bands. The kilns are located on a hillside to provide operation from top and bottom levels, thus facilitating the handling of the wood. The plant site was chosen as near the center of the wood source as possible, on a good country road, where both water and power were available. Object of the pilot plant was to determine the yield, cost of harvesting the wood and the markets available. Another objective is to clear the hardwood stands, retaining only the pine for seed trees to encourage natural reproduction.

Predominant woods are the various oaks, hickory, and a small percentage of gum. The wood is cut in standard four foot cord lengths, split only when necessary to aid in handling. Limbs, poles and crooked sections are cut into 12" lengths and placed in the top of the kiln to aid in packing and also to speed up handling the irregular wood. Yield averages about 800 pounds of charcoal per standard 128 cu. ft. cord.

The charcoal is packed for domestic trade in 5, 10 and 40 pound paper sacks. This is sold through a distributor. Approximately ten percent of the production is so-called fines, which can be considered waste production.

The economics of a charcoal plant has a number of factors to be considered. The production of charcoal is a marginal operation. Other advantages can be gained such as clearing land, utilization of wood waste and steady employment of labor. The cost of the wood to the kiln is the largest controlling factor. Operations of loading, firing, and unloading approximately double this cost. The use of charcoal is quite common but markets for large volumes are limited to certain localities. Charcoal is bulky, dirty and carries premium hauling rates. The cost of selling, packaging and hauling also increase the production cost. Other than the kilns, buildings for holding bulk charcoal and storage facilities for packaged units must be provided. The necessary trucks, saws and hand equipment to cut and handle the wood will vary on each location but can be figured with considerable accuracy.

Charcoal production is a complimentary rather than independent operation. If a charcoal plant could be located in a hardwood lumbering area where wood is cut on a sustained yield, then the tops, culls, slabs and edgings would provide the wood source. Supervision and night shift could serve on both mill and charcoal operations. To complete the ideal plan a chemical plant to take all production should be accessible. Perhaps there will never be an ideal location but there should be a few that fit most of the requirements.

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Shipworms—From page 69

oride, silver nitrate, DDT, lead naphthanate, chlordane, strychnine, etc. Some of those which proved effective were too expensive to use.

Q. Have you had any experience with Limnoria?

A. They are somewhat more treacherous than teredo in that they can tolerate more creosote.

Q. Is creosote a toxic or merely a repellant?

A. Research was conducted in Miami whereby teredo larvae were placed in water that had small traces of creosote. A drawn-out tube was made that would hold only one teredo larva and the tube was arranged with a monometer that could measure the respiration of a single larva. At a creosote concentration of 1:5,000,000,000, the respiration of the larva was reduced by 50%. That is the first indication to my knowledge that there are substances in creosote toxic to teredo larvae. Creosote is not, of course, toxic to adults, for if one nails a block of wood to a creosoted log, the organism will go into the block and then into the creosote.

Q. Has it been established whether the teredo and other types of borers go into the wood for shelter or to provide food substance?

A. I am reasonably sure they do digest the cellulose portion of the wood, but it is not their sole source of food as there is not enough nitrogen in the wood.

Q. What about the six weeks hibernation period?

A. The ship-worm lives on its glycogen.

Q. Is sodium arsenite injurious to man in the concentration mentioned?

A. If one drank it, it might be, but it does not seem injurious to the

skin in dilute solution. The fish are our greatest worry, but we feel that the moment the solution spreads out from the raft, it will be diluted so rapidly that it will not be injurious to fish.

Q. I am not quite clear as to when you intend to spray the raft.

A. The idea is that the company would tow the raft out in the inlet as far as possible and wait for good weather; the raft would then be sprayed if it had been in water for more than three months. We assume this treatment will kill most of the adult shipworms already established. There is a chance of reinfestation of the raft, but damage from a second attack will not be significant until 6 weeks have elapsed. During this period it is our hope that the raft will reach the mill and be used.

Q. How long is it between the time a raft is made and the time it is towed?

A. It takes six weeks to collect logs in a bag boom and another week to make the raft. The logs are thus in the water a minimum of 7–8 weeks. All we can hope to do by applying poison is to extend the life of the raft. It costs $300 to spray a raft, and this may have to be repeated, but theoretically, the damage to one raft can be as much as $20,000.

Oak Wilt—From page 71

quent years. The underground spread of oak wilt from tree to tree through root grafts has been stopped by poisoning all healthy oaks within 50 feet of the diseased trees. In suppressing oak wilt, the surrounding healthy trees should be poisoned or the area should be inspected early in the following summer and annually for several years to determine if additional trees have become diseased. In forest stands it is usually more economical to poison the surrounding trees at once rather than make additional inspections to locate subsequent oak-wilt infections and treat them and the surrounding ones.

Much research has been conducted on oak wilt but much more remains to be done. It is of primary importance to determine how the disease spreads a considerable distance from an infected area to healthy trees. This knowledge may provide a basis for the development of better control measures. Our present knowledge of the disease and its occurrence indicates that two general conditions exist that must be considered in initiating a control program:

1) In those areas where oak wilt has been present the greatest length of time, the disease is well established, many infection centers are large, and a suppression program would be very costly. The oak values in some of these areas are not high and in some wood lots the cost of eradicating diseased trees might exceed the value of the remaining trees. In many other wood lots the oak values are higher and a control program might be justifiable. The State of Minnesota is testing control measures on an experimental basis in three areas, involving about 5,000 acres of heavily infected oak forests. It is hoped that the results of their work may serve as a guide to the adjacent States, and determine the practicability of arresting the spread of the disease under similar conditions.

2) In the Ozarks and throughout the East the situation is quite different. Here the percentage of diseased trees is small and oak values are much higher. The cost of eradicating all of the oak-wilted trees would be insignificant in comparison with the value of the residual oak forests. A disease suppression program could be justified on a unit basis. The units might consist of a distinct forest area, individual counties, or better still, an entire State or group of adjacent States.

Some States have already initiated oak wilt control programs and others are considering doing so in the near future. In Michigan, property owners are being asked to destroy all oak-wilted trees. Oak wilt has been found in 56 counties in Ohio, and the State is endeavoring to eradicate all of the diseased trees. Pennsylvania is conducting a vigorous control program, and Maryland is eradicating oak-wilted trees in their three western counties. West Virginia is testing control measures in some counties. Kansas is destroying all oak-wilted trees. The only oak-wilted tree found in Virginia was destroyed. Plans are being made to initiate control programs in North Carolina, Tennessee, and Kentucky. An extensive experimental program was initiated in southern Missouri in 1952; this should serve as a guide for future control activities both there and in Arkansas.

Future Activities

The Federal Government and various States will cooperate in surveys for oak wilt in the summer of 1953. The success of attempts to arrest the spread of oak wilt are dependent upon a knowledge of the location of diseased trees. It will be necessary to continue surveys to locate trees that were not found earlier and those that become diseased after the first known infected trees have been eradicated.

It is exceedingly doubtful if all oak-wilted trees can be found in any State. The disease is sometimes obscure on white oaks, and the forested areas too extensive to permit a careful examination of individual trees. By using airplanes for locating wilted trees, large areas can be examined at a reasonable cost and most of the diseased trees located. This should be adequate for the suppression program outlined above and appears to be the most practical solution to the oak wilt problem.

The cooperation of all is important and oak wilt infections found in new areas should be reported to Federal or State agencies conducting surveys.

Laminated—From page 75

lapse of time, in this case 23 minutes from start of glue spreading to complete pressure, to eliminate the possibility of pre-cure. The laminars are clamped under 150-lb. pressure per square inch. Approximately 300 clamps are used.

Now the jig is covered with special thermal blankets made of two layers of canvas with fibre-glass insulation between and a vinylite lining on underside, and the temperature under the blankets is brought to 195-degrees Fahrenheit. The vinylite lining acts as a moisture barrier. The heat is held for six hours after a glue-line temperature of 150° is reached at the innermost glue line. The rib will remain under heat and pressure up to a maximum of 215° for 14 to 15 hours.

Next day, the blankets are removed, and the overhead crane raises the fabricated frame from the jig. This frame of oak is stronger than steel, pound for pound. It is three times stronger than solid wood. The section is perfectly stable; that is, temperature or humidity will not cause the "U" to open or close. In tests, the wood will break before the glue will part.

The keel is made in a 70-foot spar press. This keel is made up of 30 fir planks, scarfed as previously described. Since the press is only 70 feet long, the keel must be made in two sections, then these scarfed. The fir members are cured at 140° for one hour at the innermost glue line, under pressure of 150 lbs. per square inch.

Piling—From page 30

Q. Have you driven larch piles?

A. (Murray) Yes, in eastern Oregon. They stand up quite well.

Q. Are there any basic objections to western hemlock?

A. (Gurd) There are some objections in the treating phase. We have treated some hemlock and results were very erratic. Some coast hemlock treats very well; some other not so well. Tests so far haven't shown any methods of treating hemlock which guarantees first class results. We are not encouraging the use of treated hemlock, therefore, until we can be sure of results.

A. (Murray) Hemlock piles split more readily in driving. If the ground is soft, and if the piles do not require hammering too long, they will be satisfactory provided that they are kept dry.

A. (Alexander) We have not had any experience with hemlock piling but we have had considerable experience with western hemlock poles. The big difficulty in effecting preservative treatment is (the lack of uniform penetration that the preservative does not penetrate uniformly) There are some cases of heavy penetration and other cases where it is very difficult to get any penetration in the wood cells. In some cases penetration is 1¼" occurs and perhaps two feet from here that section penetration is the thickness of a cigarette paper.

Q. How long was the hemlock seasoned before treatment?

A. (Alexander) One full year, piled on skids in the open. These were 25-foot poles that were tested at the Vancouver Laboratory.

A. (Thurston, Totem Pole & Piling Co.) A pole company with which I have had experience has found that the penetration of pentachlorophenol was deeper and more uniform in hemlock than in fir or larch. The full length hot and cold open tank system was used. It has been our experience with hemlock on the Coast that a certain rigidity or brittleness develops immediately after cutting. It's not like fir regardless of the period of seasoning. With hemlock the breakage is perhaps ten times that of either fir or cedar. Also, in loading on flat cars hemlock is like loading steel pipes.

Q. Is the trend toward chemicals other than creosote increasing all the time?

A. (Gurd) Records show that the use of chemicals other than creosote, or solutions with creosote, is increasing somewhat for some products other than piling.

A. (Alexander) Statistics will show that in no year has there been more than five percent of the total piling treated with materials other than creosote or petroleum-creosote mixtures. When it is considered that creosote and creosote and petroleum oil account for 95 percent of a total of 3,600,000 FBM. The amount of material treated with all other chemicals is not large.

Q. Is there any way other than test loading to determine the load bearing capacity of piling prior to driving?

A. (Cook) The only safe way is to test load. In clean material the E.N.R. formula is satisfactory and I think in fairly plastic clay it can be assumed that the skin friction is equal to the cohesion. The E.N.R. formula is totally inadequate for fine soils or organic clays because they drive very poorly. In one case the E.N.R. formula showed 4½ tons for the working load and after we had put 17½ tons on it we couldn't even get a movement of 1/64th inch.

Q. (Lewis) In regard to your statement concerning the relative fire retardance of treated wood and plain wood, is that tied in with sludge on the outside of the timber, or with age? The American Railway Association is trying to cut down the fire damage on timber trestles during the first year of life. I gathered from your paper that creosote-treated piling was more fire resistant than an untreated pile.

A. (Gurd) I am thinking of a reasonably clean job of treating with creosote oil. The hazard is reduced after a period of seasoning which is preferably one year. If there is a heavy coating of tarry sludge on the material the problem may be somewhat different.

(Cook) I heard Mr. Murray mention that he has seen some locations where the piling driven didn't meet any specifications, due to spiral grain, yet when it comes to hard driving there are no better piles. Regardless of what resistance is obtainable from the soil, most codes say that 20 tons is the limit. I wonder if the specification could be too rigid.

(Alexander) It depends upon whether a straight column load is applied to something like slide rock formation or whether the entire load is borne by skin friction. It would also depend on fixity of the ends.

Q. You gave an average strength reduction of 12½ percent for creosoted material. What is the basis for that reduction? What type of material did you test?

A. (Alexander) Sawn timbers, incised, pressure creosoted, 6" x 12" x 13 ft., tested by third-point loading on a 12-ft. span.

Q. Was that on full length treatment?

A. Yes, full length, dry material.

Q. Would the data apply to long piling where an extended seasoning period is required in the kiln?

A. (Alexander) I cannot see why it wouldn't apply to piling. How high do you go in your temperatures?

A. The maximum allowed by the AWPA is 220° F.

(Gurd) We don't usually go that high. Our cycles are usually 200° to 210° for about 36 hours in the case of green piling.

(Alexander) I am doubtful if you would get any significantly different results. Round treated material would give about the same bending results for poles or piles. We ran a test which showed that the modulus of elasticity in square timbers was not affected by any temperature up to 250° F. Other strength properties were affected but not the stiffness factor.

Q. (Murray) Did you say you got a better job of treatment in piling which were mechanically peeled?

A. (Gurd) Yes. The treatment is more uniform, the treatment period is shortened and less severe checking occurs.

Q. (Murray) It seems to me that the mechanical peeler has a tendency to remove too much sapwood.

A. (Gurd) The amount of sapwood removed normally is not in excess of ⅛ inches and as the minimum specification for buying piling is ¾ inches this should not present any problem. Most piling for treatment is of the second-growth type and has sap rings from ¾ inches to a maximum of 3 inches.

(Alexander) We found that less than one in three of 1000 piles examined had 80 percent heartwood, indicating that a very low proportion would be acceptable for use as export piling.

Q. Do you recognize any increase in stress with other than impact loading?

A. (Cook) No, I wouldn't say so without considerable knowledge of the geological formation.

Q. On what basis would it be different for sawn timber?

A. (Alexander) In the majority of structures, beams, stringers and columns are tied together in such a manner that there can be little vertical or lateral movement.

Piles cannot be tied at their tips, which may be moved laterally by lateral loads or by earth slippage which will result in eccentric loading, when the butts are fixed, and cause excessive unit stresses in the piles. The critical factor to be kept in mind constantly is settlement. Small uniform settlement may not be serious, but large or differential settlement may be disastrous if allowed to develop and continue. Such settlement is more likely when the loads are borne entirely by skin friction between the pile and soil.

Q. (Lewis) In your comparative bending tests was maximum toughness computed? If so, was any reduction in amount indicated for the factor of heating time? In bending the modulus of elasticity will not be affected, but we did find an appreciable change in toughness.

A. (Alexander) You are speaking of maximum load in static bending as an index to shock resistance. We did not make any impact bending tests on material 2" x 2" x 30", nor on full sized beams. These static bending tests were made some years ago.

Q. Have we any competition from materials other than wood as far as piling is concerned?

A. (Murray) The rising costs of timber piling are bringing it to a point where steel will be highly competitive. Building codes allow the development of full stresses in steel but timber piles are limited to a load of 20 tons. Composite piling can often be used to advantage. In dry foundation work, where the water table is 20 feet below the surface, an untreated timber pile can be used with confidence below the water level with another type of pile spliced to it to reach the required height. There are a number of composite piles involving the use of a metal sleeve which overlaps the top of the pile.

Abstracts

The preparation of abstracts from world literature in many languages is so highly specialized and costly that the Forest Products Research Society has no abstracting service of its own. For the abstracts in this issue of the JOURNAL the Society is indebted to the respective abstract journals indicated, from which they have been selected with the kind permission of the editors. Readers wishing information in addition to that given in these abstracts should consult the original articles referred to. Copies or additional information can not be supplied by FPRS or the abstract journal. The journals from which abstracts are published in this issue are as follows:

BULLETIN OF THE INSTITUTE OF PAPER CHEMISTRY, published monthly at Appleton, Wisconsin by the Institute of Paper Chemistry, subscription price $25 per year. This Bulletin publishes over 3,600 abstracts per year on subjects of interest to manufacturers of pulp, paper, fiber board and allied products.

CHEMICAL ABSTRACTS, published semimonthly by the American Chemical Society, Executive Office—1155 Sixteenth Street, NW, Washington 6, D. C., subscription price $60 per year plus postage. This abstract journal publishes many thousands of abstracts annually with broad coverage of world literature in the entire field of chemistry and allied subjects.

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TECHNICAL BULLETIN OF THE FURNITURE DEVELOPMENT COUNCIL is published bimonthly by the Council at 11 Adelphi Terrace, London W. C. 2, England. The Technical Bulletin publishes hundreds of abstracts and reviews from world literature annually, relating to the various phases of the furniture manufacturing industry. Subscription price is $5 per year.

General

Yearbook of forest products statistics 1951. FAO, Rome. 1951. pp. 182. [E.F.Span.]

Contains new information for 1950 and revised data for 1949, for more than 100 countries. [For. Prod. Util. Abs., V. 13, No. 5]

Statistics tell Canadian story in relation to industrial growth. *Canada Lumberman, Toronto* 71 (10), 1951 (48–9). X.

Gives some figures for timber and wood products showing industrial production, employment and earnings in forestry and timber manufacture, time lost in labour disputes, wholesale price indexes, sawn timber production, value of retail trade, exports, and freight carried on Canadian railways, for the years 1939, 1950 and 1951. [For. Prod. Util. Abs., V. 13, No. 5]

Research facilities of the Forest Products Laboratories Division. Ottawa Laboratory. Vancouver Laboratory. *Mimeo. For. Prod. Lab., Can.* No. O–161, 1952. pp. 6. [For. Prod. Util. Abs., V. 13, No. 5]

Ritchie, James L., and Bettendorf, Harry J. Wood pulp and pulpwood statistics. Fibre Containers 37, no. 8: 136, 138, 140, 142, 144–7 (August, 1952 *cf.* **B.I.P.C. 22: 118–19.**

The wood pulp consumption of the United States in 1951 totaled 18,500,000 tons, almost three times that of 1935. This phenomenal rise in demand is ascribed to population increase and, to a much greater extent, to an increase in per capita consumption. It is pointed out that, although a pulp supply may be adequate to meet overall national requirements, it may be quite inadequate as regards a particular grade of pulp; individual consumers must then be prepared to alter their wood-pulp requirements within reasonable limits. A sharp trend toward North American self-sufficiency in wood pulp production is evident and capacity promises to reach 22,333,300 tons in 1955. Adequate supplies of wood will be available if there is a continued effort toward improved silvicultural methods and complete utilization of the current supply of wood resources through a broadening of the range of suitable wood species and the control of fibre waste. The oversupply of pulp and paper at present is discussed briefly. The authors attribute this situation to the operation of an inventory cycle in pulp products and an expansion cycle in pulp and pulp products. The latter may have a strong impact on supply-demand relationships unless the industry learns to generate new demand to absorb the growing supply. Numerous tables, diagrams, and pie and block charts. [Bul. Inst. Paper Chem., V. 23, p. 112]

Blanford, H. R. Forestry in relation to the paper and board industry. Proc. Tech. Sect., Brit. Paper and Board Makers' Assoc. 33, no. 2: 321–32; discussion: 333–6; (May, 1952); World's Paper Trade Rev. 138, no. 11: 815–18, 823–4 (Sept. 11, 1952).

A brief survey of the world supply of pulpwood from natural conifers and hardwoods is given; the coniferous forests are being utilized to capacity on a sustained yield basis and no exportable increase may be expected from America or Europe (excluding Russia). Local regions with forest wealth will develop these supplies for their own use. The prospects seem good for developing suitable areas with short-rotation pure crops of fast-growing conifers and eucalypts for pulp production; however, the possible necessity for rotation of crops or proper treatment of the soil and correct forest hygiene must be kept in mind to prevent soil deterioration and damages from insects and disease. [Bul. Inst. Paper Chem., V. 23, p. 171]

Wood and Its Properties

Sandermann, W. Die Methodik radioaktiver Spuren in der Holzforschung und Holztechnik. [Radioactive tracer methods in wood research and wood technology.] *Holz Roh- u. Werkstoff* 10 (3), 1952 (81–7). 30 refs. [G.g.] P.R.

Describes their application in (1) determining the age of timber, (2) physiological research (e.g) photosynthesis, N fixation), and (3) measurement of paper sheet thickness. The references are mostly British and American. [For. Prod. Util. Abs., V. 13, No. 5]

Kinloch, D., and Miller, W. A. Gold Coast timbers. Government Printer, Gold Coast. 2nd ed., 1949. pp. xii + 39 + 3 tbls. + 1 map.

The first edition of this booklet was published in 1941 [cf. *For. Abstr.* 3 (307)]. The information given for each of a number of species includes weight, colour, durability, impregnation, seasoning, working qualities, and uses. [For. Prod. Util. Abs., V. 13, No. 5]

Gomes, P., and Fernandes, H. Florestas amazonicas. [The Amazonian forests.] *Carib. For.* 12(4), 1951 (141–58). [Port.e.span.]

Notes on the vegetation and climate of the region, transport facilities, exploitation and exports, with a list of the most important timber species classified according to their uses, and giving their vernacular and botanical names and the specific gravity of the timber. [For. Prod. Util. Abs., V. 13, No 5]

Surinam timber—a summary with brief descriptions of the main timber species of Surinam. Surinam Forest Service. [1952?]. pp. 35 + 1 tbl. 57 refs.

Descriptions of individual species, their mechanical and physical properties, uses and local and botanical names. [For. Prod. Util. Abs., V. 13, No. 5]

Physiology of heartwood formation. *Rep. For. Prod. Res. Bd., Lond. 1950,* 1951 (10–1).

An experimental girdling technique has been worked out at Princes Risborough for interrupting the flow of sap without seriously interfering with the vitality and normal physiological activities of the tree. Observations so far show that some, but not all, of the changes that occur in normal heartwood formation can be induced in this way. It is too early to say whether results will lead to the discovery of a practical method of accelerating the change from sapwood to heartwood or of increasing the heartwood % in commercial timber. [For. Prod. Util. Abs., V. 13, No. 5]

Timber mechanics: test methods. *Rep. For. Prod. Res. Bd., Lond. 1950,* 1951 (23–4).

Discusses testing methods, the relative advantages of samples with cross-sections 2 in. and 2 cm. square, and the findings of recent international conventions, held under the auspices of F.A.O., on a standardized scheme of testing. [For. Prod. Util. Abs., V. 13, No. 5]

Abrasion. *Rep. For. Prod. Res. Bd., Lond. 1950,* 1951 (25).

The effect of different drying treatments on wearing qualities of home-grown Oak has been investigated. Abrasion tests indicate that neither the relatively high temperature used in kiln-drying nor an appreciable over-drying to a low moisture content followed by re-wetting, reduces resistance to wear. [For. Prod. Util. Abs., V 13, No. 5]

Schaefer, W. Die Zugfestigkeit lamellierter Stäbe. [Tensile strength of laminated bars.] *Holz Roh- u. Werkstoff* 10 (1), 1952(15–8). [G.g.] P.R.

Results of experiments conducted in 1943 in three German laboratories. It was found that when a tension bar is made of several lamellae, the breaking stress in relation to the total cross-section is less than the average value calculated from values for the individual lamellae, often even less than the value for the weakest lamella. A 'calculated value' depending on the number of lamellae, can be derived statistically for the evaluation of tensile bars, but this value leads to premature breakage in 4% of all cases. It is thus better to use the 'minimum value'. [For. Prod. Util. Abs., V. 13, No. 5]

The mahagony book

Mahogany Association Inc, U.S.A. 1951, 72 pp, illus (free)

A broad outline is given of historical references to mahogany, the chief sources of supply and the characteristics of the tree and its wood. A table is included showing the average physical and mechanical properties of the timber. Substitutes used for mahogany are noted and parts of furniture in which substitutes may be found are pointed out. In America, copyright labels and tags are used to guarantee that a piece consists of genuine solid mahogany or mahogany veneers.

Mahogany chairs typical of different periods such as Chippendale, Hepplewhite, Sheraton etc, are illustrated. [Tech. Bul. F.D.C., V. 2, No. 12]

Effects of tension wood in hardwood lumber and veneer

M. Y. Pillow (Forest Products Laboratory, U.S.A.)

Southern Lumberman, U.S.A., Vol. 185 No. 2312, 1 August 1952, pp. 44, 46, 48–9, 7 illus, 5 refs.

Tension wood results from abnormal growth of fibres in leaning trees and branches. Its most serious characteristic is its greater shrinkage along the grain than normal wood resulting in a high tendency to warp and sometimes to split. Tension wood also causes rough machining such as torn grain on a planed surface, and is frequently associated with collapse in drying. In veneer, tension wood may cause distortion due to warping and lead to a fuzzy surface.

Indications of the presence of tension wood are projecting fibres on sawn surfaces particularly when these are confined to definite areas, and tearing of the grain during the first planing. Streaks of tension wood can sometimes be detected by visual examination. The abnormal fibres tend to be darker in colour than normal wood in such species as mahogany, and have a denser appearance with an almost glass-like sheen when many are present. The wood may also have a silvery or lustrous appearance in light-coloured aspen and beech.

It is not necessary to reject all timber containing tension wood, since it may be suitable for some purposes. Relatively short, thick pieces, for example, are less likely to warp than long, slender pieces. In veneer it may be possible to clip out the areas affected. Detection of tension wood in expensive cabinet woods for sliced veneer should begin with the flitches so that those containing tension wood can be segregated. [Tech. Bul. F.D.C., V. 2, No. 12]

Timber Harvesting and Lumber Manufacturing

Megille, V. de. Une solution au probléme de la manutention pour les scieries de moyenne et petite importance. [One solution of the handling problem in medium and small sawmills.] *Rev. Bois Appl.* 7 (4), 1952 (19–21). [F.]

An illustrated description of a new lightweight, rotatable winch with a horizontal pulley, which, working over one of two other pulleys arranged in suitable positions, facilitaes the hauling of logs from the log dump to the cross-cut, and thence to the main saw. The cable consists of a multiple steel-wire core covered with hemp; only the 3-m. long end portion of the cable is bare. The same winch can be used for unloading logs from a lorry or for rolling logs to a considerable distance. [For. Prod. Util. Abs., V. 13, No. 5]

Bell, G. E. Gang saw production higher in small log conversion. *Canada Lumberman, Toronto* 71 (9), 1951 (86, 188). X.

A limited study was made at one mill on sawing by gangsaf (932 logs) versus circular headrig (637 logs). Results show that: (1) the gangsaw produced 5% more lumber, 4% less sawdust, 1% less trim, and the same volume of slabs and edgings; and (2) the gangsaw required on an average 20 man-minutes/M. bd. ft. more than the circular headrig. All logs entering the mill were scaled by two log rules; overrun for both rules was 9% higher for gang-sawn logs. At present prices, this extra volume would have a value of more than $5,000 per million ft. of lumber sawn, against an increase in labour costs of only $300. [For. Prod. Util. Abs., V. 13, No. 5]

Wilson, G. M. Control of costs of slasher mill operation. Pulp Paper Mag. Can. 53, no. 9: 146, 153, 155–6, 158, 160 (August, 1952).

The author describes the methods employed by the Johns–Manville Corporation to control logging costs and thereby achieve maximum production per dollar spent. Time-study engineers studied felling, skidding, and slasher mill operation for efficient methods and equipment. Most efficient use of labor was obtained after a wage-incentive system based on production over standard time production was set up. Time-rating methods are discussed. 5 tables. [Bul. Inst. Paper Chem., V. 23, p: 134]

Veneer and Plywood

Kübler, H. Neue Maschinen für die Sperrholzindustrie. [New Machines for the plywood industry.] *Holz Roh- u. Werkstoff* 10 (4), 1952 (144–57). 6 refs. [G.g.] P.R.

An illustrated description of modern German squaring saws, peeling machines, clippers, patching machines, machines for head-joint trimming, taping machines, multiple-blade circular saws, glue-spreaders, presses, machines for final trimming, polishing machines, and scraping machines. [For. Prod. Util. Abs., V. 13, No. 5]

Keylwerth, R. Der Verlauf der Holz-temperatur während der Furnier- und Schnittholf-trocknung. [Temperature variation during the seasoning of veneer and converted timber.] Holz Roh- u. Werkstoff 10 (3), 1952 (87–91). 3 refs. [G.g.] P.R.

The results of wood temperature measurements are discussed. During the convection seasoning of veneer, three stages were observed: (1) a relatively short preheating stage during which water vapour condenses on the veneer surface below the dew-point temperature, (2) a stage of dynamic equilibrium, when the largest proportion of moisture is evaporated, and (3) the end stage when the veneer temperature rises steeply. In order to obtain a high-quality product, it is advisable to control the various zones of the kiln climate, to provide for a large output of the blower (fan) and for the reversal of the air current, and to have a conditioning zone adjacent to the kiln. Shorter seasoning periods can be attained by using contact drying (between warm metal plates and rollers). During the seasoning of converted timber two critical phases can be observed—the establishment of the moisture gradient indispensable for proper seasoning, and the crossing of the fibre-saturation point. The former is associated with external cracks and cup-shakes, the latter with internal cracks (in hardwoods). The end of the seasoning occurs when the surface and inner temperatures of timber are the same. Admixture of air can reduce the amount of yellowing, during high-temperature seasoning, owing to the lower cooling limit. Seasoning with hot steam does not cause undesirable changes in wood, but requires greater circulation of the gas phase or a periodic reversal of the current. [For. Prod. Util. Abs., V. 13, No. 5]

Plywood commercial standard established. *B. C. Lumberm.* 36 (2), 1952 (60).

Summarizes a grading standard established by the Plywood Manufacturers Association of British Columbia. [For. Prod. Util. Abs., V. 13, No. 5]

Glues and Gluing

Carruthers, J. F. S., and Thomas, A. M. Investigations into glues and gluing. Progress report 62. The comparative durability of plywood glues in England and in Nigeria (Series IV). Forest Products Research Laboratory, Princes Risborough. 1951. pp. 11. P.R.

The adhesives tested included those of the phenolresorcinol-, melamine-, and fortified and normal urea-formaldehyde type. Plywood for tests was made from 3 ×0.064-in. Beech and Gaboon. Test panels open-piled in a workshop at Princes Risborough showed negligible deterioration of all the glues after 12 months, while panels fully exposed showed incipient deterioration of the urea-formaldehyde glues. So, too, did panels piled in stick under an open-sided shed in Nigeria, while panels fully exposed there showed a degrade in melamine-formaldehyde, incipient deterioration in fortified urea-formaldehyde, and deterioration in normal urea-formaldehyde resins. *From authors' summary.* [For. Prod. Util. Abs., V. 13, No. 5]

Special heating methods for glue-setting: low voltage heating [for wide material.] *Rep. For. Prod. Res. Bd., Lond. 1950,* 1951 (28–9 + 1 photo).

The use of low-voltage heating (a sheet-element system relying on conduction from a surface) has in the past been limited to narrow work, owing partly to the difficulty in handling the very large currents needed for wide elements, and partly to the fact that non-uniform heating is likely to occur. Suitable equipment has now been designed for heating areas up to 3 or 4 ft. wide. The method and equipment are described with illustrations. [For. Prod. Util. Abs., V. 13, No. 5]

Special heating methods for glue-setting radio frequency heating. *Rep. For. Prod. Res. Bd., Lond. 1950*, 1951 (29–30).

A graphical representation, with the voltage and duration of treatment plotted against each other, of results of tests on the limiting behaviour of glues heated by the glue-line method is given, showing various zones where the glue does not set, breaks down by electrical arcing or gives weak joints for other reasons, and a central zone of safe setting conditions. The standard 5-ply Beech block test piece has been modified and improved, and the quality of the bond is now gauged by measuring the force needed for splitting open the glue line. Results of tests on synthetic resins show that urea-formaldehyde glues behave satisfactorily, but the phenolic and resorcinol types tested tend to break down by arcing. [For. Prod. Util. Abs., V. 13, No. 5]

Woodworking Equipment and Methods

Sawing research. *Rep. For. Prod. Res. Bd., Lon. 1950*, 1951 (31–4).

Summarizes research on: depth of tooth penetration for band, circular and circular-rip saws; maximum feed permissible for different numbers of teeth; and the volume of sawdust per tooth in relation to gullet space. [For. Prod. Util. Abs., V. 13, No. 5]

E.A.F. Dinglinger

Carbide-tipped tools reduce woodworking costs

Ubersee-Post, Germany, Vol. 17 No. 4, 16 April 1952, pp. 21–5, 3 refs, 15 illus. (English Edition)

A good illustrated account is given of carbide-tipped tools developed in Germany. To exploit the advantages of these tools care must be taken to choose the proper type of carbide and a suitable design of tool. The carbide cutting edge must be mounted free of stress and the method of brazing is therefore very important. The tools described are brazed by a new laminated process known as the 'Diatom Capillary Grid'.

Tables are included in the article showing the comparative costs of carbide and high-speed steel tools for the following operations: sawing glued wood, cutting laminated wood, machining plywood and drilling glued radio housings. A list of German manufacturers of the tools described is given. [Tech. Bul. F. D. C., V. 2, No. 11]

Wood Finishing

Browne, F. L. Natural wood finishes for exteriors of houses. *Rep. U.S. For. Prod. Lab., Madison* No. *R*1908, 1951. pp. 9. P.R.

A general account of oil, wood sealer, and varnish finishes, their application to large-pored hardwoods, and to doors and windows. [For. Prod. Util. Abs., V. 13, No. 5]

Wood Construction

Morozov, N. A. Opyt potocnogo proizvodstva stenovyh detalei bruskovyh i karkasnyh domov. [Experience in the continuous production of wall elements for board- and panel-construction houses.] *Lesn. Prom.* 1950 (7), (20–2). [Russ.]

An illustrated description of their production for sectional board-construction houses and for sectional panel-construction houses.] *Lesn.* ingrad house-building factory. [For. Prod. Util. Abs., V. 13, No. 5]

Timber prefabs—what are their hazards? *Fire Prot., Lond.* 15 (139), 1952 (203). P.R.

Incidence of fires in wooden houses erected in Scotland since the war has not been unduly high. To reduce the risk, the essential requirement is to allow plenty of space between the houses and a chimney-flue height of at least 3 ft. above ridge level. [For. Prod. Util. Abs., V. 13, No. 5]

Wooden floors—sundry information. *Technical Division Report, Office of Technical Services, U.S. Dept. of Commerce, Washington* No. *IR*-6510 [*n.d.*] pp. 4. P.R.

Residential flooring in the U.S.A. is ca. 85% hardwood—primarily Oak, of which ca. 90% is strip flooring of random length, and ca. 5% parquet floor. Hard Maple comes next after Oak, and in industrial floors it is more commonly used than Oak. Little glued parquet is being made. The general practice is to mill the tongues from the full wooden strip. Floors are usually finished with a penetrating sealer after sanding. [For. Prod. Util. Abs., V. 13, No. 5]

DeGrace, R. F. Timber bridges. *Pacific Road Builder and Engineering Review, San Francisco* 76 (3), 1951 (18–20, 25–6, 28). D.S.I.R.

Discusses the merits of glued laminated timbers ('glulam') used in the construction of timber bridges, and describes fabricating methods, pressure treating with preservatives, decking made of laminated wood, maintenance, and assembly. [For. Prod. Util. Abs., V. 13, No. 5]

Utilization of Low Grades and Waste

Kolesnikov, S. N., Meljnikov, S. E., Sesukov, N. G., and Ktorov, A. V. Briketirovanie othodov derevoobrabotki. [Briquetting of wood waste.] *Lesn. Prom.* 1950 (12), (20–2). [Russ.]

An illustrated description of a briquetting plant, including the pneumatic transport of waste, designed by the authors. Small, and comminuted large, wood waste goes to the cyclone and thence to the hopper. The briquetting press weighs 12.5 metric tons; its total thrust is 100 tons, the specific briquetting pressure 1000 kg./sq. cm., and output per hour 3,600 briquettes measuring 16 × 6.8 × 3 cm., and weighing 350 g. each. [For. Prod. Util. Abs., V. 13, No. 5]

McCabe, L. C. Atmospheric pollution. *Industr. Engng. Chem.* 44 (4), 1952 (111*A*–112*A*). P.R.

Stresses the need for properly designed multiple-chamber wood-waste incinerators, as the single-chamber (silo) types now in use are not easily controlled and often produce smoke, eye irritants, ash and soot. Technical details of multiple-chamber incinerators are outlined. [For. Prod. Util. Abs., V. 13, No. 5]

Ellwanger, L. Suspension burning of bark refuse. *Tappi* 35 (3), 1952 (108–11). P.R.

Illustrated description of a bark-fed boiler furnace utilizing flash-drying and extreme furnace turbulence. The typical heat balance at heavy load was: loss due to dry gas., 5.9; to moisture and H in fuel, 13.7; to CO, 0.2; to unburnt combustibles, 1.0; to radiation, 0.5%; hence actual boiler efficiency (by difference), 78.7%, at 123,000 lb./hour steaming rate. [For. Prod. Util. Abs., V. 13, No. 5]

Carpenter, R. D. Amount of chippable waste at Southern Pine sawmills. *Tappi* 35 (3), 1952 (145*A*-147*A*). P.R.

The results of a study conducted in 1948–9 at 16 sawmills in northern Louisiana and in southern and central Arkansas. On the basis of their sawing equipment, the mills were divided into 4 classes. The logs were mostly Loblolly and Shortleaf Pine, all peeled before sawing; they were practically all of second-growth timber with very little heartwood. The proportion of chippable waste ranged between 0.43 (1st-class mills) and 0.61 (3rd- and 4th-class) cords/million bd. ft. The highest proportion of waste was found

in the lowest diameter group (6 in.); only for the 4th-class mills was it found in the 8-in. diam. group. The proportion of total waste that was chippable declined from 97% for 6-in. logs to 91% for logs > 17 in. The amount of total and chippable Pine waste from study logs (ca. 700 logs for each mill class) is tabulated and instructions are given for predicting, with reasonable accuracy, the production of total heavy wood waste at most mill cutting Southern Pine. [For. Prod. Util. Abs., V. 13, No. 5]

Pulp and Pulp Production

Goss, W. C. (to United States Sheetwood Company, Seattle, Wash.). Method of manufacturing sheet wood. *U.S. Patent* No. 2,581,652, Jan. 8, 1952. pp. 6 + 4 dgms. P.O.

A semi-colloidal bonding agent is produced by wet grinding of wood that has decayed to a condition of brown rot, and the sheets are then made by the usual compression of loosely matted pads between the platens of a steam-vented press at 250–550° F. [For. Prod. Util. Abs., V. 13, No. 5]

Seasoning and Preservation

Aaron, J. R. Problems in the selection of timber for water cooling towers. *Quart. Rev. Timb. Developm. Ass.* 3 (5), 1952 (9).

Discusses damage by *Chaetomium globosum;* the abnormal alkalinity of water treated with a softening agent; the abrasive action of falling water containing siliceous particles; and the destructive pressure exerted by sulphates present in the form of permanent hardness in the water if the towers are allowed to dry and the sulphates to crystallize out. Outlines proposed research by the Timber Development Association, the British Electricity Authority, and the Forest Products Research Laboratory, to be carried out at the British Electricity power station at Connah's Quay, Flintshire. [For. Prod. Util. Abs., V. 13, No. 5]

Kneale, R. E., and Tamblyn, N. Project P. 9: Properties of wood preservatives, Sub-project P. 9–4: Tests of metallic naphthenates prepared from different naphthenic acids for use as wood preservatives. Progress report No. 3. The toxicity of naphthenic acid and copper naphthenate to wood destroying fungi. Division of Forest Products, Commonwealth Scientific and Industrial Research Organization, Melbourne. 1951. pp. 16 + 7 gphs. P.R.

The toxicity of several types of naphthenic acids was found to vary widely, increasing as the acid number of the crude acid increased. The toxicity of Cu naphthenate also was related to the acid number, but while samples with high acid number were just as toxic as the corresponding crude acids, those with lower acid numbers were more toxic than the corresponding acids. [For. Prod. Util. Abs., V. 13, No. 5]

Radio frequency drying. *Rep. For. Prod. Res. Bd., Lond. 1950,* 1951 (20).

Beech squares, 8 × 8 in. in cross-section, were dried from green state without checking or honey-combing in less than 2 hr. The abnormally high shrinkage which occurred could be reduced somewhat by final steaming or reconditioning. The possibilities of drying thick baulks of aircraft Spruce were investigated, but this species proved very difficult to dry by the boiling method [cf. *For. Abstr.* 12 (No. 3229)] without bursting. Semi-dried and some green material was seasoned satisfactorily by this method using very low power, but this took up to 14 hr., the strength properties were probably reduced, and bursting was not always avoided. Samples of a number of exotic timbers have been tested but with a few exceptions they either burst or charred as a result of the treatment. [For. Prod. Util. Abs., V. 13, No. 5]

Wood Chemistry and Chemical Utilization

Brauns, F. E. The chemistry of lignin. Academic Press Inc., New York. 1952. pp. xv + 808 + 9 photos. 3021 refs. Price $14.50. P.R.

Includes sections on: evolution of lignin chemistry; definition and distribution of lignin; colour reaction of lignified materials; lignin isolation, determination, physical properties, elementary composition and constituent groups; acylation and acylysis; alkylation; halogenation; nitration; sulfonation; hydrolysis; alcoholysis; mercaptolysis; phenolysis; reduction, hydrogenation, and hygrogenolysis; oxidation; alkali fusion; thermal decomposition; biological decomposition; theories on lignin structure; linkage in the plant; theories on lignin formation and synthetic lignins; and an author and subject index. [For. Prod. Util. Abs., V. 13, No. 5]

Lawton, E. J., Bellamy, W. D., Hungate, R. E., Bryant, M. P., and Hall, E. Studies on the changes produced in wood exposed to high velocity electrons. *Tappi* 34 (12), 1951 (113*A*–116*A*). 15 refs. P.R.

[Cf. *For. Abstr.* 13 (No. 1535).] The cellulose in Basswood [*Tilia* spp.] exposed to sufficient doses of ionizing radiation (1.0×10^8 equivalent röntgen units) becomes largely available for rumen bacteria. The irradiated wood has a food value approximately equal to that of hay for rumen bacteria. Studies of cellulose and lignin as well as wood indicate that cellulose is more readily broken into soluble products by ionization radiation than lignin. Cellulose is depolymerized to reducing sugars which are in turn destroyed by higher doses. The results do not support the view that lignin is an 'encrusting layer' around cellulose in Basswood. *From authors' conclusions.* [For. Prod. Util. Abs., V. 13, No. 5]

Amos, G. L. Some siliceous timbers of British Guiana. *Carib. For.* 12 (3; 4), 1951 (133–7; 139–40). 6 refs. [E.Span.e.]

Forty-seven timber species were examined for SiO_2 contest; the results are listed. Of these 13 were highly, 8 moderately, and 26 inappreciably siliceous. The species accumulating SiO_2 belonged to 4 genera only—*Parinari, Eschweilera, Licania and Pouteria.* [For. Prod. Util. Abs., V. 13, No. 5]

The use of wood in association with metals. *Rep. For. Prod. Res. Bd., Lond. 1950,* 1951 (46–7).

Discusses general conclusions on corrosion by wood of metals, especially aluminium, from observations made at Princes Risborough over a period of years. The following recommendations are made for wood/aluminium assemblies: (1) The wood should be coated with bitumen or some and kept as dry as possible during service. (2) Where wetting of the wood during service is probable, all metal parts in direct contact with it should be coated with bitumen or some other electrically neutral barrier. (3) Woods which, when wet, engender a pH substantially less than than 5.0 or above 7.0 should be avoided unless dryness during service can be ensured. (4) Composite structures using wood and aluminium should be designed to avoid bi-metallic action. [For. Prod. Util. Abs., V. 13, No. 5]

Schweisheimer, W. Wood dust and respiratory diseases. *Wood* 17 (5), 1952 (181).

Discusses some cases in the woodworking industries of irritation to the

respiratory organs and to the skin caused by wood dust. [Cf. *For. Abstr.* 13 (No. 3343).] [For. Prod. Util. Abs., V. 13, No. 5]

Lipsitz, P., and Lollar, R. M. The improvement of the tanning potential of lignin by chemical modifications. *Journal of the American Leather Chemists' Association, Easton, Pa.* 46 (5), 1951 (301–17). 35 refs. L.S.

Five water-insoluble and one water-soluble lignin derivatives obtained from lignin by chemical modifications designed to increase their H-bonding ability, were used to tan calfskin, and yielded leathers having characteristics not obtainable with the unmodified lignosulphonate tannage (increased shrinkage temperature, and resistance to enzymatic hydrolysis). A bisulphated Mg lignosulphonate resorcinol condensate is an excellent water-soluble tanning material. [For. Prod. Util. Abs., V. 13, No. 5]

Lewis, H. C. Distillation of wood and coal by the fluidized powder process. *Research Engineer, Atlanta, Ga.* 1951/52 (1), (5–6, 17–9). 4 refs. L.S.

Describes a new process consisting essentially in contacting the solid substance with a gas by suspending the powdered solid in an upward moving stream of the gas under such conditions that the solid forms a dense, but highly agitated bed. This results in a very rapid heat transfer and, consequently, an almost complete disappearance of temperature inequalities within the bed. At the same time, the reactions involved in distillation occur much more rapidly owing to the greater surface area of powdered solids. [Cf. *For. Abstr.* 11 (No. 2117).] [For. Prod. Util. Abs., V. 13, No. 5]

Vroom, A. H. Bark pyrolysis by fluidization techniques. *Pulp Paper Mag. Can.* 53 (5), 1952 (121–4). 8 refs.

Comminuated air-dry White Spruce bark was readily pyrolysed at temperatures up to 265 and 460° C., using the fluid-bed technique with N, CO_2 or superheated steam as the carrier gas. Results are tabulated. In this method, gas is passed at increasing speeds through a bed of ground bark until the whole bed is agitated and the surface of the bed appears like a violently boiling liquid. When this state is reached the gas pressure differential is roughly equivalent to the weight of the bed. The gaseous products, readily isolated when steam was used, contained principally CO, CO_2, CH_4 and some H. The yield was approximately 2.3 cu. ft./lb. dry bark and its heating value about 260 B.Th.U./cu. ft. for pyrolysis at 400°. The organic distillate amounted to about 20% and contained a complex mixture of compounds, including waxes, resins, phenols, and acetic acid. Another important product was 32–34% free-flowing, granular, easily pulverizable, pyrophoric charcoal with a fuel value roughly equal to that obtained by burning the equivalent weight of undried bark. The method appeared adaptable to continuous commercial operation in portable or large-scale installations. Experiments with Black Spruce, Balsam Fir and Douglas Fir barks have also been made and other barks should be equally suitable. [For. Prod. Util. Abs., V. 13, No. 5]

Ancient industry thrives on Tanbark Oak [Lithocarpus densiflora] in California's Humboldt County. *Timberman* 53 (6), 1952 (82 . . 92).

Gives particulars of the collection of tanbark, with information on the chemistry of the bark, figures of bark yields, details of wood properties and kilning schedules, and information on the tanning process. [For. Prod. Util. Abs., V. 13, No. 5]

Arruda, E. Rezende De. O barbatimao. [Stryphnodendron barbatimao.] *Arq. Serv. flor., Brasil* 4, 1950 (101–17). 10 refs. [Port.]

This tree has considerable commercial importance, from its tanbark, usually harvested in Brazil by stripping the trees after felling. The author describes the tree, its geographical distribution and silvicultural requirements, with notes on methods of raising from seed, planting out, and tannin extraction, and on the properties of the bark and the industrial processes used at the Cia. Extrativa de Taninos S/A. [For. Prod. Util. Abs., V. 13, No. 5]

Freudenberg, Karl. The origin of lignin in plants. Holz Roh- u. Werkstoff 10, no. 9: 339–41 (September, 1952). [In German]

This is a summary of the author's recent researches in this field carried out in collaboration with a number of co-workers (*cf.* particularly B.I.P.C. 22: 830). 2 figures. [Bul. Inst. Paper Chem., V. 23, p. 178]

Miscellaneous

Joranson, Philip N. "Extra-heredity" aspen breeding initiated in Wisconsin. Paper Mill News 75, no 38: 112, 114, 116 (Sept. 20, 1952); *cf.* B.I.P.C. 12: 143.

The breeding program is outlined which the Rhinelander Paper Co. and Marathon Corp. support at Beloit College for developing extra-heredity types of aspen (tetraploid or triploid types) in Wisconsin. 1 table. [Bul. Inst. Paper Chem., V. 23, p. 84]

Nicholas, N. Violin research. *Research, Lond.* 2(5), 1949 (221–4.) 36 refs. O.R.S.

Discusses the results of research on the effect on violin quality of various factors, including wood thickness, varnish and chemical treatment. [For. Prod. Util. Abs., V. 13, No. 5]

Nicholas, N. Violin research by instrument synthesis. *Research, Lond.* 2(5), 1949 (237–42). 5 refs. O.R.S.

Factors studied included the acoustic properties of different woods, and further research on this subject is proposed. Photographs are given showing the frequency of vibration of strips of Pine cut along and across the grain, Pine cut with the grain and varnished, Maple, Cherry and Balsa. [For. Prod. Util. Abs., V. 13, No. 5]

Dantin-Gallego, J., Armayor, A. F., and Riesco, J. Some new toxic woods: some manifestations of toxicity. *Industrial Medicine and Surgery, Chicago* 21 (2), 1952 (41–6). [Instituto Nacional de Medicina y Seguridad del Trabajo, Madrid.] D.S.I.R.

A small series of cases is reported involving mill workers handling a shipment of exotic woods ('Caobillas de Guinea', not unlike Mahogany) from Spanish Guinea. Severe reactions (skin and respiratory troubles, asthmatic symptoms) caused closing of the mills. The condition is attributed to the inhaling of wood dust, the glucoside content of which gives rise to saponines that act as allergens. It is not known whether the fungi present in many woods, or the chemical action of the wood itself, are responsible for the condition. The irritation is produced only by finely comminuted wood. [For. Prod. Util. Abs., V. 13, No. 5]

Yavorsky, J. FPRS Forum. What are the machining requirements for lumber being electronically edge-glued? How long a period should be used in an R.F. edge-gluing operation? What voltage should be used during an R.F. edge-gluing operation? *Wood, Chicago* 57 (3), 1952 (44–5). P.R.

ALABAMA
W. T. Smith Lumber Co., Chapman

ARKANSAS
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Bradley Lumber Co., Warren
Crossett Lumber Co., Crossett
Dierks Lumber & Coal Co., Mountain Pine
Southern Lumber Co., Warren

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National Wood Treating Corp., Oroville
Scott Lumber Co., Inc., Burney
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Rilco Laminated Products, Inc., St. Paul

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OHIO
The Baker Wood Preserving Co., Columbus
The Baldwin Co., Cincinnati
The Kirk & Blum Mfg. Co., Cincinnati
The Mead Corporation, Chillicothe

OREGON
Cascade Pacific Lumber Co., Portland
Cascades Plywood Corporation, Portland
J. Neils Lumber Co., Portland
Oregon Lumber Co., Baker
Stimson Lumber Co., Forest Grove
West Coast Lumberman's Assn., Portland

PENNSYLVANIA
Firth Sterling Steel & Carbide Corp., Pittsburgh
Frick Company, Waynesboro
Koppers Company, Inc., Pittsburgh
Perkins Glue Co., Lansdale

SOUTH CAROLINA
Lightsey Brothers, Miley

TENNESSEE
E. L. Bruce Co., Memphis
Chapman Chemical Company, Memphis
Memphis Hardwood Flooring Co., Memphis
Tenn. Products & Chemical Corp., Nashville

TEXAS
Wm. Cameron & Co., Inc., Waco

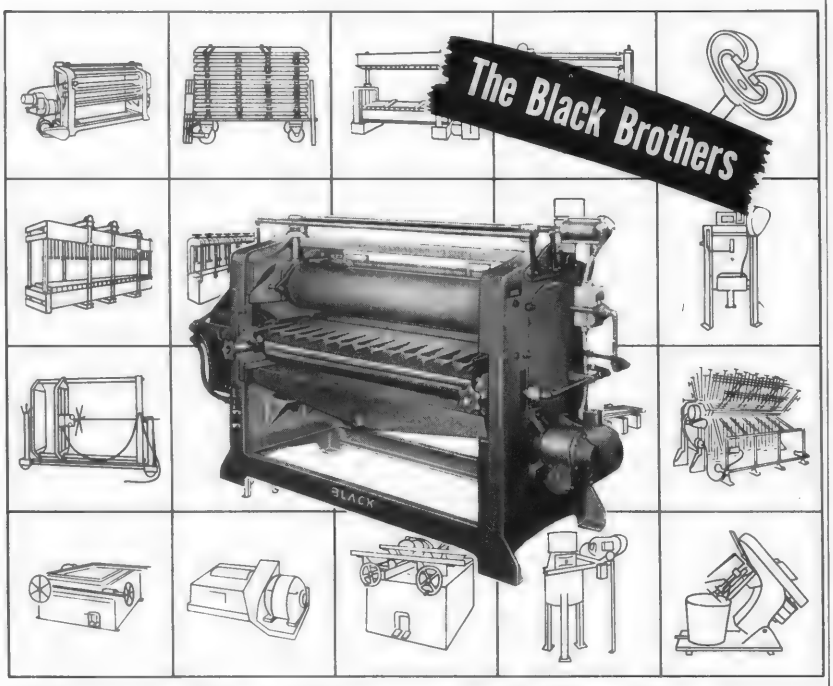
VERMONT
Fyles & Rice Co., Inc., Bethel

WASHINGTON
American Marietta Co., Seattle
Deer Park Pine Industry, Inc., Deer Park
Douglas Fir Plywood Association, Tacoma
Eatonville Lumber Co., Tacoma
Simpson Logging Co., Shelton
The Long–Bell Lumber Co., Longview
Simpson Logging Co., Shelton
Weyerhaeuser Timber Co., Tacoma

WISCONSIN
The Buckstaff Co., Oshkosh
Holt Hardwood Co., Oconto
Marathon Corp., Rothschild
Mosinee Paper Mills Co., Mosinee
D. J. Murray Mfg. Co., Wausau
Paine Lumber Co., Oshkosh
Rhinelander Paper Co., Rhinelander

ALASKA
Ketchikan Spruce Mills, Ketchikan

CANADA
British Columbia Lbr. Mfrs. Assn., Vancouver, B. C.
Canadian Forest Products Limited, New Westminster, B. C.
Dominion Electrohome Industries, Ltd., Kitchener, Ont.
MacMillan & Bloedel Limited, Vancouver, B. C.
A. S. Nicholson & Son, Ltd., Burlington, Ont.



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FPRS NEWS-DIGEST

FOREST PRODUCTS RESEARCH SOCIETY, P. O. BOX 2010, UNIVERSITY STATION, MADISON, WISCONSIN

Volume 3 | FEBRUARY, 1953 | Number 2

FPRS Executive Board to Meet With Memphis National Meeting Committee, March 9, 10

The entire FPRS Executive Board, including President Ken Chesley, 1953 Meeting General Chairman Moss B. Christian, and Program Chairman R. D. Pauley will meet at Memphis with '53 meeting Chairman W. J. Eason and his Committee members to review the budget and final plans for the June 15–16–17 parlay.

Other subjects on the agenda at the two-day Board meeting include: An increased operating budget for 1953; expanded publication and advertising programs; formation within the Constitution of a National Advisory Committee, to be made up of Section Officers of the Society; membership plans; 1954 meeting at Grand Rapids, Mich.; 1955 meeting plans at Vancouver, B. C.; current status of Subject Matter Committees and Sections; analysis of Student dues and services; and a proposed Abstract Service for members.

Report: Current Status of Nominations of Candidates for 1953–54 FPRS National Posts

With March 15 the last date for filing names of candidates through committee channels, one national and two Regional FPRS Nominating Committees have reported progress.

The National Nominating Committee has to date announced the following candidates:

For President-Elect—L. J. Carr, L. J. Carr Co., Sacramento, Calif. Carr is currently Vice-President of the Society.

For Vice-President—Moss B. Christian, Chicago Mill and Lumber Co., Tallulah, La., presently South Central Regional Board Member and E. E. Dargon.

For Nominating Committee—Harold Z. White, St. Maries Lumber Co., St. Maries, Idaho; Theodore C. Combs, Arch Rib Truss Corp., 4819 Exposition Building, Los Angeles, Calif.; Arthur L. Mottet, Long–Bell Lumber Co., Longview, Washington; A. R. Colman, Bell Telephone Co. of Canada, 1425 Beaver Hall Hill, Montreal, Quebec, Canada; Charles H. Jeter, A. J. Hodges Industries, Inc., 604 Johnson Bldg., Shreveport, La.; Ellwood S. Harrar, School of Forestry, Duke University, Durham, N. C.; Monie S. Hudson, Taylor–Colquitt Co., Box 1491, Spartanburg, S. C.; Frank T. Parrish, Heywood Wakefield Co., Central Street, Gardner, Mass.

The Southeast Regional Nominating Committee has presented one candidate, Walter Buehler, Lakeland, Florida, as successor to the post currently held by E. E. Dargon, Conway, S. C.

The South Central Region has not yet reported.

Secretary Schedules Advertising–Membership Trip

In conjunction with the FPRS board meeting at Memphis, Tenn., Frank J. Rovsek, Executive-Secretary Forest Products Research Society, plans a two week trip to call on major forest products industries' suppliers in St. Louis, Indianapolis, Cincinnati, Knoxville, Chattanooga and Nashville, as well as several intermediate cities.

Rovsek also expects to call on as many Section Officers, Committee Chairmen and Supporting Members as possible to discuss Society affairs.

In his advertising calls, Rovsek will stress the vastly increased value of the new, modern format of the FPRS publications, their wide acceptance and recognized authority. Rovsek will point out that a high percentage of FPRS readers including executives, owners, managers and directors of wood industry operations, are key factors in control of purchases.

Chicago Furniture Market

We have heard, unofficially, that the Chicago Summer Furniture Market dates have been changed to June 22–July 2. If so, there will be no conflict with our National Meeting, June 15–17, at Memphis, making possible a large turn-out of FPRS furniture people. —Frank Parrish, FPRS Northeast Section Chairman.

"Wood Award" Publicity to Schools Aimed at Wide Student Participation

Sixty-three Deans, Professors, and Department Heads, representing a cross-section of the nation's forest products educational leaders, were sent last month complete "information kits" publicising and explaining the 1953 Wood and Wood Products Award, which is conducted by FPRS and is open to any student in attendance at a North American university between May 1, 1952 and April 30, 1953.

Highlight of this year's promotion of this worthy student competition, and included in the kits sent to the schools, are large 12 by 15 inch Bulletin Board placards to announce facts about the Award directly to the students. The kits also contained sets of rules and style sheets for prospective entrants.

Tentative titles for papers must be submitted to the Executive-Secretary, Forest Products Research Society, P. O. Box 2010, University Station, Madison 5, Wis., by March 1.

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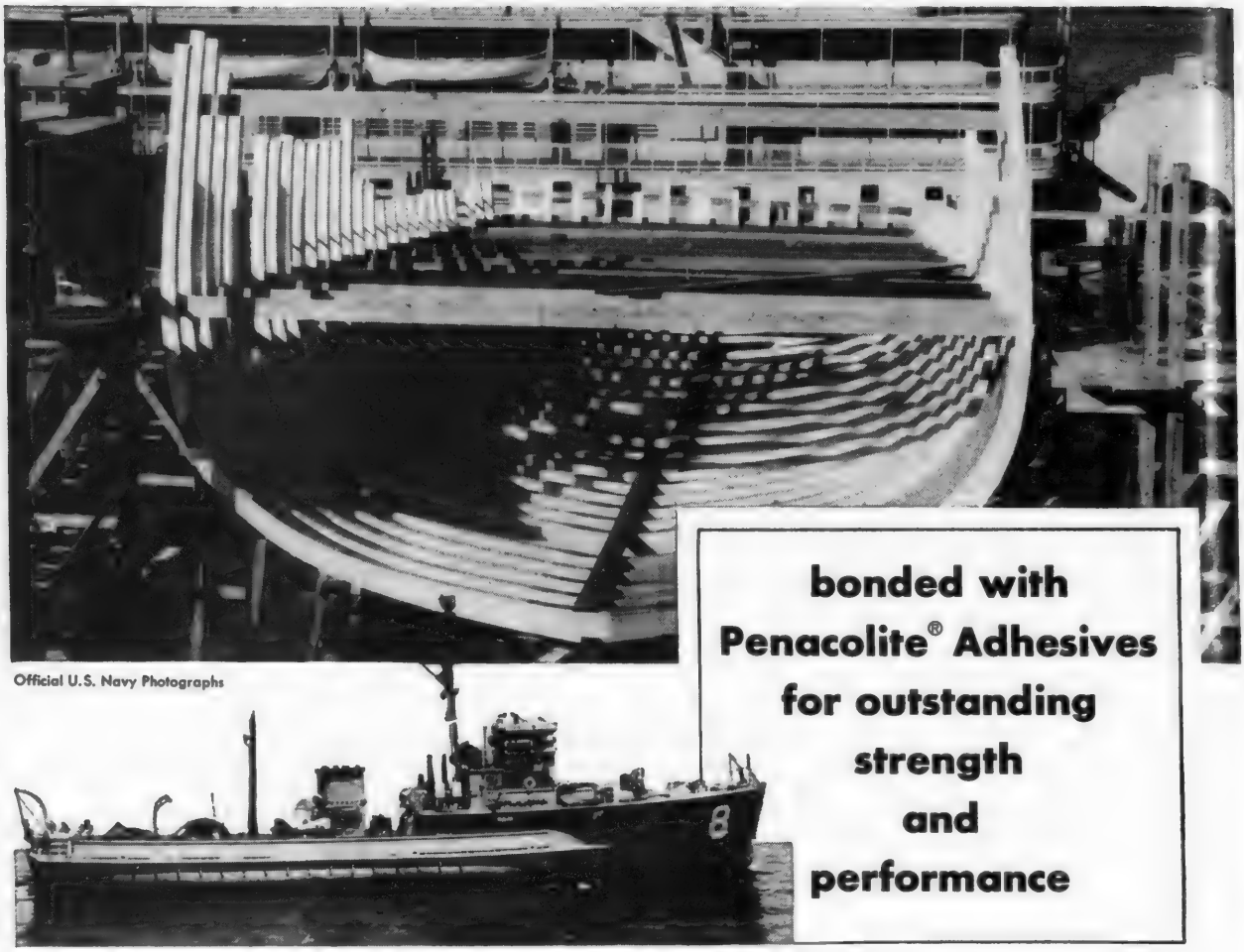

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FPRS SECTIONS

Northeast Section to Study Waste Utilization at Portland, Maine, May 7, 8

Keyed to the theme "Improved methods for more haste with less Waste," the Northeast Section will hold its spring meeting May 7–8, 1953, at Portland, Maine, Frank T. Parrish, Section Chairman, announces. Sixteen prominent authorities are scheduled to discuss "efficient log and lumber handling and processing and utilization."

The meeting will open officially on Thursday morning, May 7, with a technical session on "Improved Processing of Logs and Lumber." The regular FPRS luncheon will be held on Thursday and will be highlighted by a talk on "The Research Background of Northeastern Forest Industries" by Dr. Ralph W. Marquis, Director of the Northeastern Experiment Station.

The afternoon program will consist of Part I of the Technical Session on "How Forest Product Residues Can Be Utilized."

An evening session handled by the Maine Forest Forum will feature an open forum on "Integrated Logging."

Friday morning will be devoted to Part II of the Technical Session on "How Forest Product Residues Can Be Utilized," making a total of eight authorities who will present their views on this all-important subject.

Friday afternoon will be devoted to elective trips to see: 1) a wood flour operation; 2) the new H. B. Beam system; 3) a demonstration and discussion of small kiln.

Parrish points out that the wide range of interest of the meeting, which is under direction of Charles Lockard, Program Chairman and Section Vice-Chairman, makes it one that should not be missed.

For complete details of the program, write the Section Secretary, Wm. Delmhorst, Delmhorst Instrument Co., Boonton, New Jersey.

Treating Methods, Waste Utilization, Plywood and Veneer Problems on Program Schedule at Toronto, March 5, 6

A full schedule of technical papers and election of officers will feature the first annual meeting of the Eastern Canadian Section at the Royal York Hotel, Toronto, Ont., March 5–6.

Other features of the meeting will be the anticipated appearance of FPRS President Kenneth G. Chesley, Crossett, Ark., Eastern Regional Board Member W. Burdette Wilkins, Ridgewood, N. J., and Frank Parrish, Northeastern Section Chairman, Gardner, Mass.

Royal York Hotel, Toronto

Twelve papers will cover such subjects as wood waste and hardboards, furniture finishing, wood treating for preservation and fire resistance, mobile sawmills and wood waste utilization.

Section officers will be elected at the meeing and it has been announced that Col. F. H. Jenkins, Chief, Canadian Forest Products Laboratories, will stand for the office of Section President.

J. H. Palmason

A. R. Colman

Section Chairman J. H. Palmason, Dominion Tar and Chemical Co., Ltd., Montreal, Que., urges all FPRS members and other wood industry men to attend this important first annual meeting.

FPRS NAMES IN NEWS

"Extension Meeting" Planned

F. T. Parrish, Chairman, Northeast Section, met in Boston, February 11, with Prof. Dietz of M. I. T., Stuart Huckins, Timber Engineering Co., and Jim Tyman, A. G. Spalding Co., to line up a March FPRS District Extension Meeting on "Wood Trusses—Laminated Arches." The topic is timely due to the current high interest in laminating and timber structures.

IMPORTANT FPRS DATES

March 5, 6, 1953: Eastern Canadian Section, at Royal York Hotel, Toronto, Ont.

March, 1953: Northeast Section "Extension Meeting" on Laminated Timbers, at Boston, Mass.

March 9, 10, 1953: FPRS National Executive Board meeting at Peabody Hotel, Memphis, Tenn.

April 16, 17, 1953: Two-day meeting of Ohio Valley Section, at Chester B. Stem Co., New Albany, Ind., and U. of Louisville.

April 28, 1953: Pacific Northwest Section Meeting at Eugene, Ore.

May 6, 1953: One-day meeting of Northern California Section, at San Francisco.

May 7, 8, 1953: Two-day spring meeting of Northeastern Section, at Portland, Me.

June 15, 16, 17, 1953: FPRS 7th Annual National Meeting, at Memphis, Tenn.

FPRS NAMES IN NEWS

Deckert to Liaison Post

FPRS Member Russell C. Deckert, Syracuse, N. Y., has been appointed industry specialist in forest utilization at New York College of Forestry, Syracuse. He will serve as a liaison man between the college and the wood using industries of New York State, consulting on forestry and wood products problems of mutual interest to the forest industry and education.

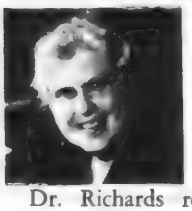
Stem Heads Walnut Group

FPRS Member Richard K. Stem, Chester B. Stem, Inc., New Albany, Ind., was recently elected president of the American Walnut Manufacturers Assn. at a meeting in Chicago. The first day of the April 16–17 meeting of the Ohio Valley Section will be held at the modern Chester B. Stem plant.

Grantham Named Lab Head

J. B. Grantham, Northwest Regional member of the FPRS Publications Committee, has been named director of the Oregon Forest Products Laboratory, Corvallis, Ore. Grantham has been acting director since last June.

Dr. Richards Passes



Dr. C. Audrey Richards, long one of the Nation's outstanding research pathologists, died at Madison, Wis.

Dr. Richards retired less than a year ago—February 29, 1952—from her career in forest pathology research for the U. S. Department of Agriculture.

West Goes to Rutgers

Richard F. West, FPRS member and former Chairman of the Deep South Section, became Head of the Forestry Department, Rutgers University, New Brunswick, N. J., effective February 1. West was formerly an Associate Professor of Forestry at Louisiana State University, Baton Rouge, La.

Besley Named to Forestry Association Post

Lowell Besley, professor of forestry and Dean of the Forestry School, University of British Columbia, has been named Executive Director-Forester of the American Forestry Association, Don P. Johnson, the group's president, has announced.

Employment, Positions Offered

For more information write FPRS office, Box 2010, University Station, Madison 5, Wisconsin.

No. E132—Manufacturer of school furniture seeks man for design engineering, and manufacturing supervision. Must be capable of making neat drawings and have the basic training for supervisory work. Experience desirable, but prefer a young man to work up.

No. E133—Chemical firm has opening for technical representative who has had insulating or hardboard plant experience and who has good background in chemistry and wood products. Location—West Coast.

No. E134—Eastern concern is interested in contacting a man to take over the duties of Hardwood Grader.

No. E135—Mill work company, New York Area, seeks recent graduates, school of forestry or wood technology.

Employment, Positions Wanted

No. 173—Civil engineer, University of Wisconsin, desires position in Midwest.

No. 174—A young man with an extensive specialized education in wood technology and utilization, and three and a half years of thorough industrial engineering experience with several large furniture manufacturers, is interested in an industrial engineering or supervisory position with a firm requiring efficient and economical manufacture of products made of wood. 27, single, draft exempt.

No. 175—Forestry Graduate (B. S. from U. of Mo.), age 22, deferred from active military duty, desires sales development or management position in Midwest, particularly in Missouri area.

No. 176—MS degree June 1953. Age 37, married. Engineering and management wood products industry; wood utilization and technology. Desire permanent type of promising position in or near medium sized or large city.

No. 177—Graduate forester, 27, Navy Veteran, with 2½ years of experience in quality control, production engineering research and supervision in the plywood industry desires position in the West or Midwest.

New FPRS Members—January

Northeast

Librarian, College of Forestry, State University of New York, Syracuse 10, N. Y.

Eastern Canadian

Fernand Diagle, Diagle Lumber Co., Ltd. 10 Charlevoix Street, Montreal, Quebec
R. G. Milne, R. Laidlaw Lumber Co., Ltd., 2280 Dundas St., W., Toronto, Ontario

Carolinas-Chesapeake

S. Arthur Hooker Arthur Hooker Sales, Inc., Box 1327, Martinsville, Virginia
William J. Johnson, (North Carolina State College), Robersonville, North Carolina
Harvey G. Carpenter, (North Carolina State College), Rt. 4, Albermarle, North Carolina

Midwest

Oliver F. Campbell, Jr. (Iowa State College) 125 North Hyland, Ames, Iowa
Thomas M. O'Neil, Jr., Masonite Corporation, 139 North Spring Ave., La Grange, Illinois
R. B. Priest, Dept. 817, Sears Roebuck & Co., Chicago 7, Illinois (Replacement)

Great Lakes

E. Brooks Applegate, Travis-Applegate Company, 714 Building & Loan Bldg., Grand Rapids, Mich.

Ohio Valley

George E. Clark, Rohm & Haas Co., 802 Hoffman Bldg., Louisville, Kentucky

Deep South

John W. Squires, Mississippi Products, Inc., Forestry Department, Jackson, Mississippi
Daniel N. Copp, Wilco Machine Works, 1301 North Hollywood, Memphis 8, Tennessee
Richard O. Wilson, Wilco Machine Works, 1301 North Hollywood, Memphis 8, Tennessee (Reinstated)

Inland Empire

Donald D. Benson, Cascades Plywood Corporation, Route 2, Box 25, Lebanon, Oregon.
E. R. Borcherdt, Anaconda Copper Mining Co., 521 Hennessy Building, Butte, Montana

Pacific Northwest

Paul R. Walsh, The Long-Bell Lumber Company, 4520 55th N. E., Seattle, Washington
Robert Dering Short, Timber Structures, Inc., 1211 S. W. 58th Street, Portland 1, Oregon (Reinstatement)
Edward J. Kirkpatrick, Coos Bay Lumber Co., 935 Montana Street, North Bend, Oregon (Reinstatement)

Foreign

Carl Sasse, Carl Sasse, Ltd., Lauenau/Diester British Zone, Lower Saxony, Germany
The Norwegian Forest Research Institute, Vollebekk, Norway, Attn. Dr. G. G. Klem
Antonio Santacruz, Palma Norte 519 Room 202 Mexico 1, D. F.
George Henry Dawson, % Singapore Plywood Co., Ltd., Box 1381, Singapore, Malaya
Winston H. Mahfood, Industrial Development Company, 140 Maxfield Ave., Half-Way-Tree, Jamaica, B.W.I.
Tom D. Ward, Dominion Sawmillers' Federation, Inc., G. P. O. Box 226, Wellington, N. Z. (Replacement)
Professor Shimizu, Tokyo University Nogakubu, Zairyo Kagaku-Kyoshitsu, 1, Motofujicho, Bunkyo-ku, Tokyo, Japan

Address Changes—January

Northeast

Robert H. Kohout, Sylvania Electric Products, Inc., 60 Woodward Avenue, Kenmore 17, New York
Richard F. West, Forestry Department, College of Agriculture, Rutgers University, New Brunswick, New Jersey
G. Klinkenstein, Maas & Waldstein Co., 2121 McCarter Highway, Newark, New Jersey
Nelson E. Wright, Keene, New Hampshire

Florida-Georgia-Alabama

Alvin A. Voges, American Veneer Pkg. Assn., 1225½ North Orange Avenue, Orlando, Florida

Midwest

A. H. Marten, National Casein Company, P. O. Box 416, Oshkosh, Wisconsin
S. S. Sakornbut, 869 Longacre Drive, University City 24, Missouri

Upper Mississippi Valley

Maurice J. Rhude, 2714 Hall Ave., Marinette, Wisconsin
Paul J. Meiners, M. B. Farrin Lumber Company, 3197 Glenmore Avenue, Cincinnati 11, Ohio
John R. Green, Ohio Valley Wood Materials Co., 1623 Heyburn Building, Louisville, Kentucky
James M. Greene, 420 Daviess Street, Owensboro, Kentucky

Deep South

E. D. Marshall, 541 Hamaonson Avenue, Lufkin, Texas
Hubert W. Gray, Nickey Bros., Inc., 995 Semmes Street, Memphis, Tennessee
Albert A. Salt, 516 South Washington St., Magnolia, Arkansas
Roswell D. Carpenter, 3805 Parkway Drive, Apt. D., Shreveport, Louisiana
Alvis W. Pyle, Jr., 2201 Houston Drive, Fountain City, Tennessee
Robert A. Christian, Crossett Lumber Company, 501-A Main Street, Crossett, Arkansas

Pacific Northwest

William H. Miles, Research Engineering Laboratory, Puget Sound Naval Shipyard, Bremerton, Washington
William M. Black, Seattle Cedar Lumber Mfg. Co., 4703 Ballard Avenue, Seattle 7, Washington
Karl Bollerslev, Oregon Forest Products Lab., 420 North 9th Street, Corvallis, Oregon
George B. Ward, Jr., Soundview Division, Scott Paper Company, Everett, Washington
Harold K. Wilson, 2926 South Moore Street, Olympia, Washington
Robert H. Ripley, Douglas Fir Plywood Association, Tacoma Building, Tacoma, Washington
Richard W. Pettersen, Douglas Fir Plywood Assoc., Rt. 6, Box 700, Tacoma, Washington
John F. Kronenberg, Coos-Curry Management Corp., Box 461, Bandon, Oregon
Donald Elliott Johnston, 835 5 Road, Lulu IS., R.R. 3, Vancouver, B. C., Canada
R. D. Watson, Weyerhaeuser Timber Company, 1644 22nd Avenue, Longview, Washington
Ralph G. Peinecke, Lawton Apartment 11, Shelton, Washington
Carl E. Laney, Reichhold Chemicals, Inc., 2027 Harris, Eugene, Oregon
Osgood H. Munger, Oregon Pulp & Paper, 215 South Winter St., Salem, Oregon
James S. Thornton, % J. V. Roslund, 244 Pacific Building, Portland, Oregon
Edward T. Clapperton, 862 South 5th Street, Apt. 5, Coos Bay, Oregon
Thomas Fleming, Jr., Glenco Forest Products, P. O. Box 1142, Sacramento, California
Hugh Irving Stroupe, James L. Hall Co., 32 Terrace Avenue, San Anselmo, California
E. B. Birmingham, Hammond Lumber Company 417 Montgomery Street, San Francisco 6, California

Foreign

Ronald Jackson, 88 Gurney Street, Darlington, County Durham, England
S. A. Clarke, Division of Forest Products Forest Products Laboratory, 69-77 Yarra Bank Road, South Melbourne, S. C. Australia
Oswald F. Wyss, Interwood A G, Bahnhofstrasse 28a Zurich 1, Switzerland

New Publications

Pulpwood from Small Woodlands. Northeast Wood Utilization Council, Bul. No. 40. Report of conference held at Montreal in cooperation with the Pulp and Paper Research Institute of Canada. Papers and discussions present a thorough investigation into the problems inherent in utilizing pulp wood, timber and veneer logs from farm and other small wood lots, as well as emphasizing the increasing necessity to call on these sources of material supply. It was recognized that wood using industries must offer the small wood lot owner a type of long range forest management plan that will promise more ultimate returns in cash income than the clean cutting of all timber, as has frequently been the practice in the past. Several papers related examples to show such long range forestry in small wood lots is feasible. Improvement cuts every ten years will yield pulpwood and at the same time build up sawtimber of high value. Mechanization, portable chippers and bark separation are all problems needing further solutions to make long range supplies of pulpwood from small woodlots economically feasible. It was also recognized that industry will need to shift its buying from agents of contractors to staff foresters who can advise owners on sound practices and who will ordinarily insist on the avoidance of clear cutting. The Bulletin is available from the Northeast Wood Utilization Council, P. O. Box 1577, New Haven 6, Conn. Price is $2.00.

Portable Band Mill Integrated with Logging Points Way to Greater Utilization. T. E. Collins and D. P. Thomas, Institute of Forest Products, Department of

(Continued on page 96)

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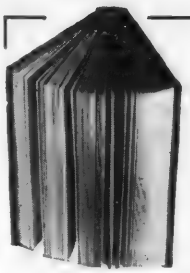

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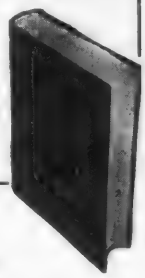

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Conservation and Development, University of Washington, Seattle 5, Wash. (Available free on request.) Describes a highly efficient portable sawmill using a band saw for the head-rig. Designed and constructed by the Tufts Lumber Co., Chehalis, Wash. An effective utilization program has been developed around this mill through close integration of logging and manufacturing methods. Logging and milling practices have been established that yield nearly six percent more lumber volume per acre in large second-growth Douglas fir timber than is obtained by conventional methods. These practices show a 70 percent reduction in logging residuals as compared to the 1949 Lewis county average for logging in similar type stands. The sawmill has been designed to handle profitably chunks and tops of five-inch top diameter that will cut out eight-foot two-by-fours. A 40 percent overrun is obtained on logs averaging 12 inches in diameter, scaled in 16 to 24 foot lengths. Available, Institute of Forest Products, U. of Washington, Seattle, Wash.

Uphill Felling Reduces Breakage. Institute of Forest Products, University of Washington, Seattle, Wash. Describes means employed to fell old growth Douglas fir uphill to avoid breakage. Using tractor wincha and cable to control direction of fall, a savings of eight thousand board feet per acre may result from reduced breakage. Ever increasing value of high-grade, old-growth logs indicates increased costs of logging incurred by uphill felling may be justified. Availalbe, Institute of Forest Products, U. of Washington, Seattle, Wash.

The Hardboard Industry in the United States, Wayne C. Lewis. Forest Products Laboratory, Madison, Wis. There has been a recent and continuing large increase in facilities for production of hardboard. The sudden increase in production, with a variety of manufacturing methods and using a wide range of species, highlights a number of interesting problems: 1) Present markets and uses need to be expanded and new ones developed; 2) Specifications for procurement need to be revised to cover the greater range in material now being produced; 3) Test procedures are needed for properly evaluating different hardboard products; and 4) A uniform system of terms relating to hardboards is needed. Possible future large expansion in the manufacture and use of hardboards suggests another way to utilize increasingly important amounts of the by-products of the forest products industry. Available, Forest Products Laboratory, Madison, Wis.

Apparent Kill of Persimmon and Sassafras by Application of 2, 4–D and 2, 4, 5–T. S. Clark Martin. Central States Forest Experiment Station, Columbia 15, Ohio. Bulletin (Technical Paper No. 112) describes screening test preliminary to more formal experiments on using above chemicals as more economical means of controlling Sassafras and Persimmon. Results so far have often been disappointing and various commercial types were tested to determine if there were any striking differences in effectiveness. Available, Central States Forest Experiment Station, Columbus 15, Ohio.

Forest Planting Possibilities on Indiana Coal-stripped Lands. Glen H. Deitschman and Richard D. Lane. Central States Forest Experiment Station, Columbus 15, Ohio. Bulletin (Technical Paper No. 131) is a thorough study of status of stripped lands, stripped lands reforested, or put to other use such as pasture or lakes, problems involved in reclaiming. Replanted areas are generally far more satisfactory than areas left to natural reforestation. Various pines are generally most satisfactory. Available, Central States Forest Experiment Station, Columbus 15, Ohio.

Survey of Sawmill Residues in East Texas. W. W. King. Forest Products Department, Texas Forest Service, Lufkin, Texas. Supplement to original report on Survey of Sawmill Residues in East Texas (Technical Report No. 3) the current bulletin (T.R. No. 3A) reports on the sawmill residues from a round-log gangmill which was recently put in operation at Livingston, Texas. For complete report on this operation turn to page ------ for "A New Round-Log Gangsaw for Small Mills," by Paul R. Kramer. Available, Texas Forest Service, Lufkin, Texas.

Standard Accounting Forms for Texas Sawmills. E. D. Marshall. Texas Forest Service, Lufkin, Texas. Relative to studying efficiency of various Texas mill operations, it was found a wide variety of cost accounting forms were used. To standardize records for the purpose of study, a committee of industry and Texas A&M College accountants developed standard cost accounting forms that are applicable to both large and small mills. Technical Report No. 5 reproduces these forms in full Although the forms were made up for Texas mills, they contain many valuable ideas for mill management generally. Available, Texas Forest Service, Lufkin, Texas.

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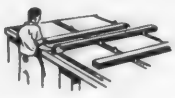

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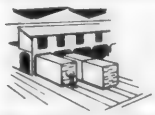

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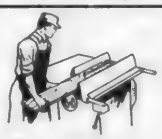

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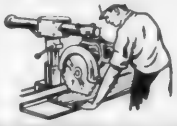

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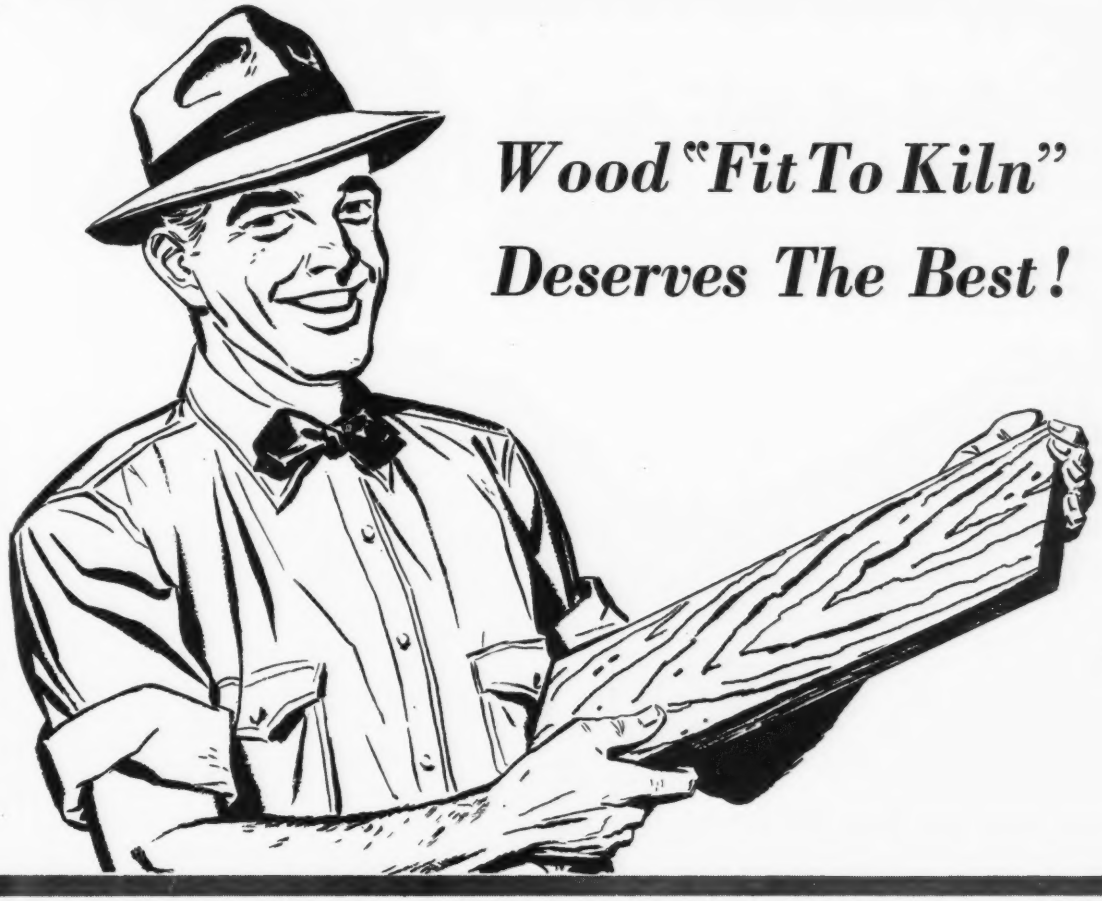

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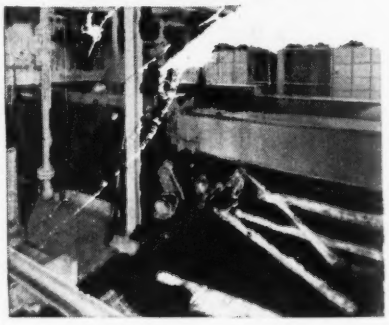

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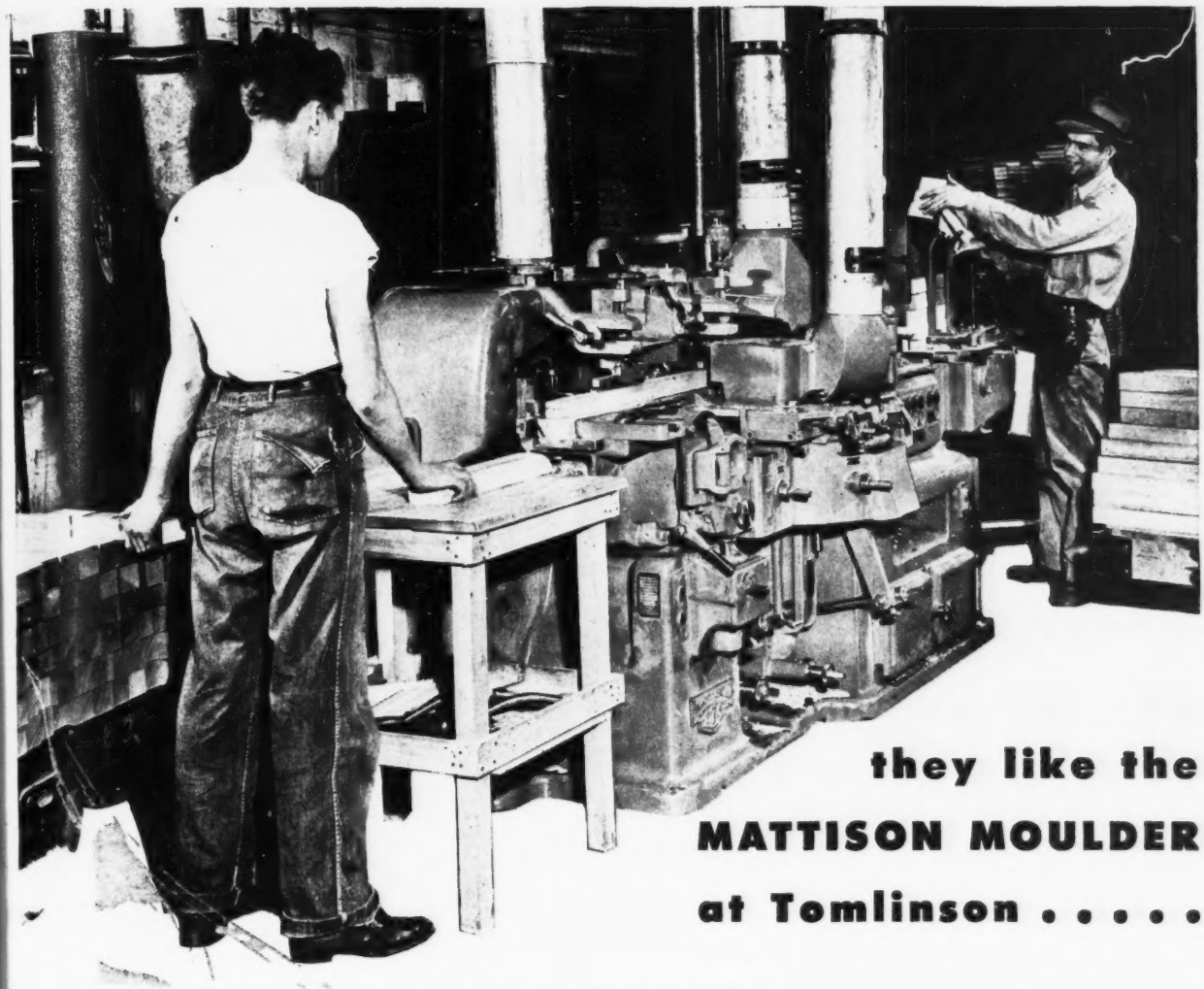

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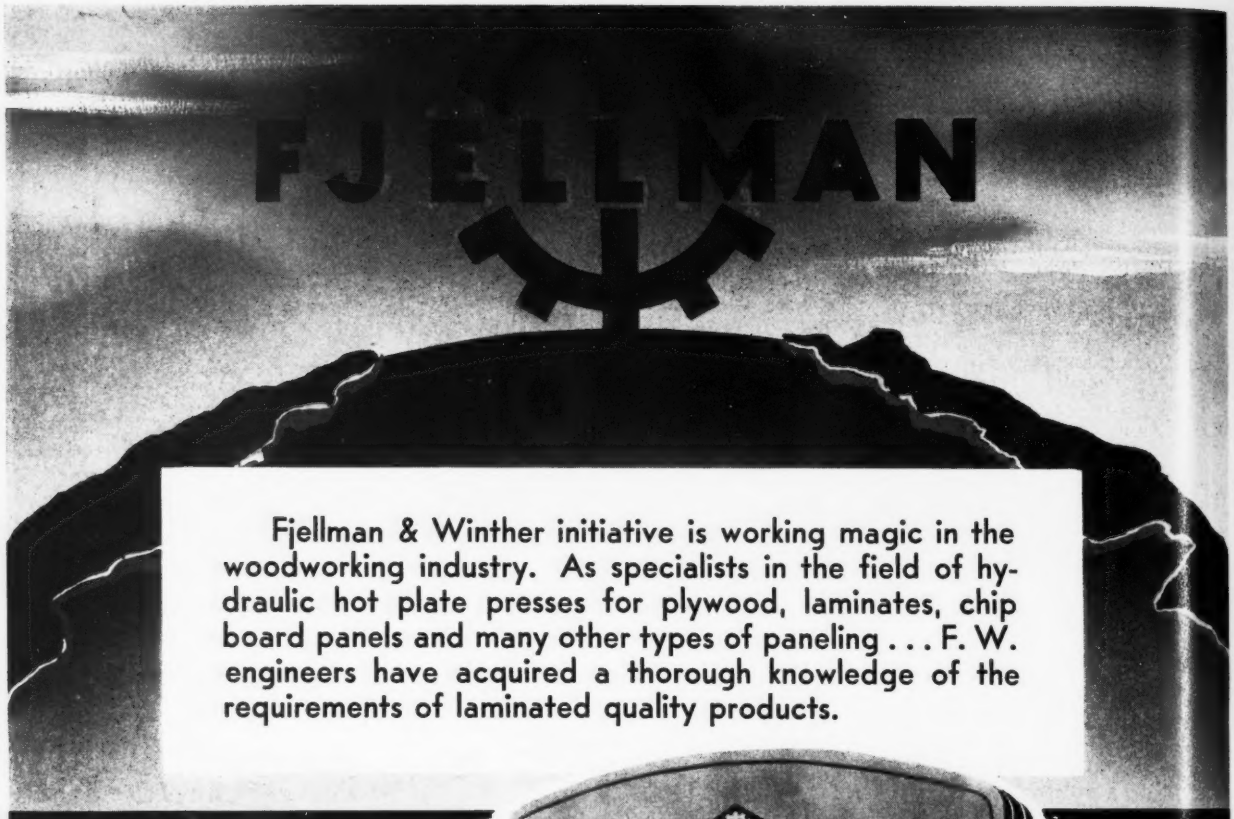

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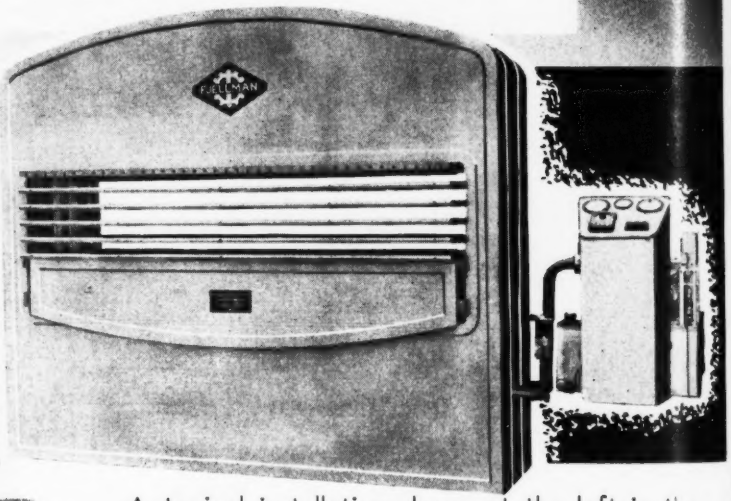

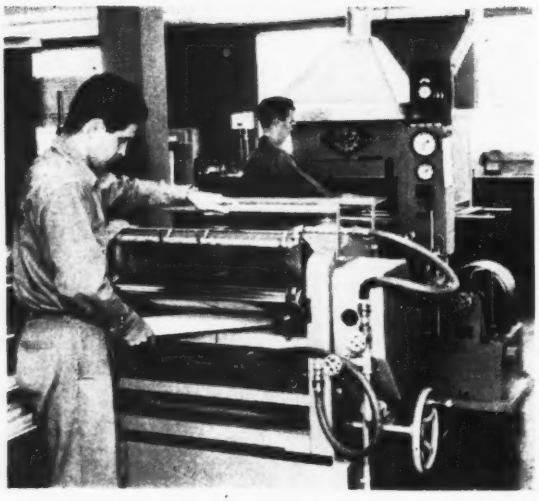

A typical installation shown at the left in the Reichhold Chemicals, Incorporated laboratories in Charlotte, N. C. plant.

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